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THE
MILITARY SURGEON

VOL. XLV JULY, 1919 NUMBER 1

ORIGINAL ARTICLES

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TYPHOID MARY

BY MAJOR GEORGE A. SOPER
Sanitary Corps, United States Army

INTRODUCTORY NOTE BY THE SURGEON GENERAL OF THE ARMY

The appearance of the following article in THE MILITARY SURGEON has a particular appropriateness in spite of the fact that the history of this remarkable woman has been confined, so far as known, to persons in civil life. It is appropriate for a number of reasons.

First, the story, substantially as it appears on these pages, formed an address which Major Soper delivered before the Surgeons of the Sixth Division to which he was attached as epidemiologist in the Army in 1918.

Second, typhoid has been brought under control largely by reason of work done to prevent the very kind of infection which "Typhoid Mary" produced. Investigation showed that a large part of the typhoid in the Spanish American War was due to contact, and the preventive treatment by inoculation which has been compulsory among United States troops since 1911 has been particularly directed against this method of transmission. And in the present war the disease has been combatted not only by attention to sanitation and inoculation, but by examining cooks and other food handlers for the carrier state in order that no person such as "Typhoid Mary" might be allowed to spread infectious material even among those who were immunized against it.

Since "Typhoid Mary" was discovered, the whole problem of carriers in relation to infectious diseases has assumed an immense importance, an importance which is recognized in every country where effective public health work is done and in every army where communicable disease has been brought under control.

The literature of typhoid now contains many examples of the carrier state such as "Typhoid Mary" exhibited; there have been some carriers who have produced more cases, but it is safe to say that it has fallen to the lot of no person to give by example a more striking lesson of the need of personal precautions in the control of disease than has been afforded by this remarkable woman. Her interesting history contains lessons which should be carefully heeded by everybody, whether in the Army or out of it.

M. W. IRELAND,
Surgeon General, U. S. Army.

THIS is the story of the cook who produced a series of epidemics of typhoid fever and was finally discovered and locked up by the New York City Department of Health. Her general history up to that

point is widely known, although few details of it can be given by most persons. Her history after her arrest forms a fitting climax to her career.

How she disappeared, produced more typhoid and was caught again, is now set down for the first time.

The great amount of attention which the case has received is due entirely to the natural interest which it possesses. The case has never been exploited for the dramatic elements which it contains, although these fairly crowd one another throughout the narrative. The circumstances of Typhoid Mary's discovery were simply announced before the Biological Society of Washington, D. C., April 6, 1907, in a brief paper. This paper subsequently appeared in a medical journal.[1] Since then no authoritative account of the case has been written. Most of the knowledge which the world possesses of it has been obtained from newspaper accounts of some of Mary's interesting movements since her original arrest.

Many inquiries have been received by me as to the history of Typhoid Mary since her first arrest, and although I have had no official connection with the matter since I brought the details to the attention of the New York City Department of Health on March 11, 1907, I seem to be regarded as the person to whom all such inquiries should be addressed.

It is in view of the scientific and popular interest in the subject which has continued now for more than a dozen years, that the following notes are made, the intention being to review the essential facts and to give notice to Typhoid Mary's movements since she was first taken into custody by the New York City Department of Health.

HER DISCOVERY

In the winter of 1906 I was called upon by Mr. George Thompson, of New York City, to investigate a household epidemic which had broken out in the latter part of the preceding August at the Thompson country place at Oyster Bay. The epidemic had been studied by experts immediately after it took place, and there were a number of typewritten reports upon it, but its cause had not positively been ascertained. It was thought by the owner that, unless the mystery surrounding the outbreak could be satisfactorily cleared up, it would be impossible to find desirable tenants for the property during the coming season.

The essential facts concerning the investigation follow:

Six persons in a household of eleven were attacked with typhoid

[1] The Work of a Chronic Typhoid Germ Distributor, George A. Soper, Ph.D. Jour. Am. Med. Assn., June 15, 1907, Vol. xlvii, pp. 2019-2022.

fever. The house was large, surrounded with ample grounds, in a desirable part of the village, among other handsome places, and had been rented for the summer by a New York banker, Mr. Charles Henry Warren.

The first person to be taken sick fell ill on August 27, and the last on September 3. The diagnosis was positive. Two of the patients were sent to the Nassau Hospital at Mineola, and the others were attended by capable physicians at Oyster Bay. None of the subsequent cases apparently resulted from the first. They seemed all to have been original infections. But, whether the disease was transmitted locally or not, the point of interest lay in the origin of the first case.

Typhoid was an unusual disease in Oyster Bay. At the time of the outbreak no other case was known. None followed.

The milk supply, cream, water and other articles of food which might have been implicated were one by one carefully eliminated as possible causes. The drainage was examined and found satisfactory. Extreme care was used in this part of the investigation in view of the fact that there was a firmly settled belief on the part of many persons that the water had become contaminated from cesspools, a privy vault or stable manure pit. Analyses of the water were made independently by two competent chemists and flourescein was used to study the possibilities of underground percolation. As a result of this particular study it did not seem to me that the water theory was tenable.

I was led from the proper track for a time by being informed that the family was extremely fond of soft clams and that supplies of these shell fish had frequently been obtained from an Indian woman who lived in a tent on the beach, not far from the house, and whose supplies of clams were sometimes taken from places that were not improbably polluted with sewage.

But if clams had been responsible for the outbreak, it did not seem clear why the fever should have been confined to this house, because soft clams formed a common article of diet among the native inhabitants of Oyster Bay. On inquiring closely, it was found that no clams had been eaten for six weeks before the outbreak of typhoid, and six weeks was too long a period for an epidemic of this character to remain undeveloped. In my opinion the infectious matter which produced the epidemic had been taken with food or drink on, or before, August 20.

The history of the house with regard to typhoid showed that no case had occurred on the premises or been nursed there, nor was it believed that a convalescent had visited it in thirteen years, and the house had been occupied every summer since then.

Attention was then concentrated on the first case of typhoid to determine whether the infection could have occurred during a temporary absence from Oyster Bay, and it was discovered that no person

who was taken sick had been on a visit away from Oyster Bay for several weeks prior to the onset of the disease.

The social positions of the persons attacked differed decidedly. The first was a daughter of the family; the next two were maid-servants. Following this, in quick succession, were the wife, and then another daughter of the tenant, and finally a gardener who resided permanently at Oyster Bay and who had lived on the place for years.

Believing that some event had occurred in the family or in Oyster Bay, which, properly studied, might give the clue to the cause of the epidemic, the immediate history of the household at this time was carefully inquired into. This gave the key to the situation.

It was found that the family had changed cooks on August 4, about three weeks before the epidemic broke out. Little was known about the new cook's history. She had been engaged at an employment bureau which gave her a good recommendation. She remained in the family only a short time,leaving about three weeks after the outbreak of typhoid occurred. Her present whereabouts were unknown.

The cook was described as an Irish woman about forty years of age, intelligent, tall, heavy, single and non-communicative. She seemed to be in perfect health. She was not known ever to have had an attack of typhoid.

Here was by all means the most important clue which had come to my notice. If this woman could be found and questioned, it seemed likely that she could give facts from which the cause of the epidemic could be ascertained. I had seen typhoid spread in large epidemics under circumstances which led me to believe that it should be regarded as a contagious disease, and I had so dealt with it when acting as expert for the State of New York in handling the epidemic of 1,300 cases at Ithaca in 1903,[2] and later as expert of the city of Watertown, N. Y., in fighting an epidemic of 600 cases in 1904.[3]

When, after much difficulty, the cook was found, no information of value was obtainable from her. She refused to speak to me or to anyone about herself or her history, except on matters which she found were already known.

Her former employers gave freely what information they could, but their minds were not wholly free from bias. Nearly all the epidemics which I was inquiring into had been investigated soon after they occurred and had been explained in a different way. The answers to my questions were therefore unconsciously framed so as to convince me that the original explanations were correct.

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[2]The Epidemic of Typhoid Fever at Ithaca, N. Y., by George A. Soper. Jour. of the New England Water Works Association, Vol. xviii, pages 431-461, 1904.

[3]The Management of the Typhoid Fever Epidemic at Watertown, New York, in 1904, by George A. Soper. Jour. of the New England Water Works Association, Vol. xxii, No. 2, pages 87-163, 1905.

Curiously enough the greatest help came from a quarter which was least expected. The office through which Mary had secured some of her situations gave me all the assistance which it possessed. This office, conducted in the name of a woman, was really run by a man. For some good reason he did not allow his own name to be known. Whether by aptitude, training, or both, this person possessed many of the attributes of a good investigator. Without his help Typhoid Mary could not have been found.

In passing, it is interesting to observe that nobody who hired Mary seems to have inquired personally into her references. It seems that the names of some of her former employers were available, but it appears not to be the custom of the patrons of fashionable employment bureaus to inquire deeply into the personal history of the servants. Mary always was accepted on the recommendation of the proprietor. He was trusted to run a genuine intelligence bureau and it is but right to say that, on the whole, he discharged his obligations admirably.

The effort to work out Typhoid Mary's history was only partly successful. There were many false clews and puzzling circumstances. The mystery which had at first surrounded her continued and was often completely baffling. Sometimes it was somebody's memory which was at fault—few housekeepers seem to know anything about their cooks, much less recall the food which they have eaten weeks and months ago. Yet this information, in some instances, was indispensable.

Sometimes it appeared that persons were deliberately refusing to tell what they knew. Twice, I think, I talked with members of Mary's family, but I could never be sure of it. Servants who had been associated with her never gave any help.

Try as I would, Typhoid Mary's whereabouts for only parts of the ten years before the Oyster Bay outbreak could be determined with unmistakable certainty. About two years of the preceding five remained unaccounted for. In ten years she is known to have worked for eight families and in seven of these typhoid had occurred. She had always escaped in the epidemics with which she had been connected.

A summary of the principal epidemics follows:

In 1904 there was an outbreak at the summer residence of Henry Gilsey, Esq., at Sands Point, N. Y. The household consisted of eleven persons, seven of whom were servants. The house was rented on June 1. On June 8 typhoid began to appear. The first case was that of a laundress. Following this three other persons were taken sick in succession. None of the family was attacked. The Sands Point epidemic was confined to the house where the servants lived. There were no other cases before or after, either in the household or in the village. The cause of the outbreak was believed to be connected in some way with the servants' quarters.

In 1902 a severe outbreak occurred in the family of a New York lawyer at Dark Harbor, Maine. Mr. Coleman Drayton had rented a cottage for the summer and just before leaving New York to occupy it with his family had engaged Mary Mallon to act as cook. Seven members of this household of nine were presently attacked. In addition, a trained nurse who came in by the day took sick. The first case occurred two weeks after the arrival, on June 17. One week later another case occurred; two days later there was a third; the remainder followed rapidly. The only persons who escaped were the cook and Mr. Drayton himself, and he had had an attack some years before. These two faced together the burden and anxiety as, one by one, every other occupant of the house fell ill. Mr. Drayton felt so grateful to the cook for the help which she gave him during the epidemic that at the end of the epidemic he made her a handsome present of money in addition to her wages, little thinking that the cause of the whole trouble lay at her door.

The Dark Harbor epidemic was investigated at the time and a written report was made upon it. The infection was thought to have been brought to the house by the maid-servant who was the first to be taken ill. It seems that the servants had access to a water tank in the top of the house and it was supposed that this tank became polluted by the first person who was attacked, thus infecting the entire household. How the original case was produced was not explained, but it was assumed with the easy logic which is familiar in many such investigations that it was contracted elsewhere.

Mary Mallon's history before she went to Dark Harbor is not clear. In 1901–02 she lived about eleven months with one family. Here a laundress was taken ill and removed to the Roosevelt Hospital, December 9, 1901. This attack occurred one month after the cook's arrival. Unlike the other outbreaks, the cause of this attack was not investigated at the time, and full information concerning it has not been available.

My earliest record of Mary Mallon's employment is in a New York family which had a summer residence at Mamaroneck, New York. In this instance a young man who made a visit to the family was attacked, his illness dating from September 4, 1904. The cook left a few days after the onset of this illness. It is interesting to observe that she had been in the family for three years without apparently being connected in any way with typhoid before this. It was believed at the time that the young man had contracted his typhoid before he came to visit the family.

Subsequent to her employment at Oyster Bay, Mary Mallon went to live with a family at Tuxedo, New York. She remained about one month—to be exact, from September 21 to October 27, 1906. On October 5, fourteen days after her arrival, a laundress was taken sick with

typhoid fever and removed to St. Joseph's Hospital, Patterson. No other case had been known in Tuxedo for several years.

HER ARREST AND EXAMINATION

When at last the cook's final whereabouts were ascertained, it was discovered that two cases of typhoid had recently broken out in the household where she was employed. These occurred a few weeks after her arrival. One patient, a chambermaid, was taken sick January 23, 1907, and removed to the Presbyterian Hospital. The doctor was first called to see the other patient, a daughter of the owner of the house, on February 8. This second case resulted fatally on February 23, 1907, the only fatal case in the record up to this time. A period of two months elapsed between the beginning of the employment of the cook and the first case. There was some doubt about the diagnosis of these cases at the time of my investigation and no opinion had been formed as to their origin. The cook was about to leave the New York house.

It was at this house that I had my first interview with Mary. I expected to find a person who would be as desirous as I was for an explanation of the way in which the typhoid had followed her. Certainly she could not have failed to be impressed by the strange fatality with which the disease had broken out wherever she went. It must have looked as though it was pursuing her. Could she be connected with it in any way? Possibly she had even thought that she had produced the epidemics.

If she were implicated in the outbreaks it was, of course, innocently. I supposed that she would be glad to know the truth and to be shown how to take such precautions as would protect those about her against infection. I thought I could count upon her coöperation in clearing up some of the mystery which surrounded her past. I hoped that we might work out together the complete history of the case and make suitable plans for the protection of her associates in the future. Science and humanitarian considerations made it necessary to clear up the whole matter.

My interview was short. It started in the kitchen and ended almost immediately at the basement door. Reason, at least in the forms in which I was acquainted with it, proved unavailing. My point of view was not acceptable and the claims of science and humanity were unavailing. I never felt more helpless.

The next interview was staged more deliberately. Mary had a friend whom she often visited at night in the top of a Third Avenue tenement. He kindly offered to manage for the meeting and one night, after her work was done, I awaited her with a physician, Dr. Bert Raymond Hoobler, one of my former assistants, whom I had called on to help. We waited at the head of the stairs in the Third Avenue house.

At length Mary Mallon came. Dr. Hoobler and I described the situation with as much tact and judgment as we possessed. We explained our suspicions. We pointed out the need of examinations which might reveal the source of the infectious matter which Mary was, to a practical certainty, producing. We wanted a small sample of urine, one of feces and one of blood. The urine and feces were to be tested for typhoid bacilli and the blood for the Widal reaction. We hoped we could get some information from Mary at the same time.

Indignant and peremptory denials met our appeals. We were unable to make any headway. Mary's position was like that of the lawyer who, on being told by the judge that the facts were all against his client, said that he proposed to deny the facts. Mary denied that she was a carrier. She referred to the Dark Harbor outbreak for proof of her helpfulness and to the gift from her employer there as testimony of the same. Far from causing typhoid, she had helped to cure it. Nothing could alter her position. As Mary's attitude toward us at this point could in no sense be interpreted as cordial, we were glad to close the interview and get down to the street. We concluded that it would be hopeless to try again.

Here my investigation came to an end. It was evident that, although I had succeeded in collecting only fragments of her history, there was a remarkable resemblance between these parts. In each instance one or more cases of typhoid had occurred in households after the cook had arrived, or among people who had come to live near her and eaten of the food which she prepared. In every instance the families had ample means and lived well, as the saying is.

The bearing which wealth may have on the chance of infection may not at once be apparent, but it was taken carefully into account in this investigation. People who live as did the families concerned in these epidemics are almost isolated from infection by their cooks by reason of the fact that nearly everything they eat is subjected to the heat of cooking after it leaves the cook's hands. The heat kills the germs The cook does not cut the bread or arrange the salad or fruit, for example. All such work is done by a butler, footman or waitress, depending upon the manner in which the housework is organized. The cook comes in much more direct contact with the cooked food of the servants; a fact which probably accounts for the relatively larger number of servants attacked in the several epidemics.

Each household had consisted of four or five in the family and from five to seven servants. Four of those attacked had been laundresses, and two gardeners permanently attached to the country places where the epidemics had broken out. All but two of the outbreaks had occurred in the country. The cook had escaped sickness in every instance. In only one case could I find that she had worked in a family where no

typhoid occurred, and as this family consisted only of three people of advanced age it is not improbable that they were immune. In all, there were twenty-six cases and one death; twenty-four of these cases had occurred in the preceding five years.

Believing that enough had been learned to show that the cook was a competent cause of typhoid, I laid the facts concerning the four principal epidemics before Dr. Herman M. Briggs, Medical Officer of Health of the New York City Department of Health, with the suggestion that the woman be taken into custody by the department and her excretions made the subject of careful bacteriological examination. I had been unable to obtain her consent to any examination whatever.

The department acted favorably on this suggestion and, after considerable difficulty, during which a number of officers had to be called upon to help, the cook was removed to the Detention Hospital of the Health Department. She reached there on March 19, 1907. She was placed in charge of Dr. Robert J. Wilson, Superintendent of the Department of Hospitals, and Dr. William H. Park, Chief of the Research Laboratories of the Department of Health. Dr. M. Goodwin did the bacteriological work under Dr. Park's direction.

My third and last attempt at an interview was after her arrest. Mary was in a separate room at the Detention Hospital. I explained that I had come to get some information from her. It was desirable to know whether she had ever had an attack of typhoid and, if so, where and when. Would she consent to give a complete history of her experience with typhoid? The information might help many. It could not possibly hurt her. It might prove very helpful in explaining her case. As matters stood, nobody accused her of deliberately intending any harm. If possible, she was to be freed from her disease-producing capacity.

This interview was shorter than the other two. Without uttering a word Mary retreated with dignity to the toilet, leaving me standing alone in the room.

It was expected by me that the germs might be found in the urine, but more probably in the stools. None was found in the urine. The stools contained the germs in great numbers. Daily examinations made for over two weeks failed only twice to reveal the presence of the *Bacillus typhosus*, and on these occasions the sample taken was perhaps too small to reveal them. The blood gave a positive Widal reaction. The cook appeared to be in perfect health.

The feces were examined on an average of three times a week from March 20 to November 16, 1907, and in only a comparatively few instances did the investigators fail to find the bacilli. During the summer months the culture plates contained only a few typhoid-like colonies. In July there were five consecutive negative tests followed by a positive one.

During August the stools showed no typhoid; in September they began to appear again; from September 11 to October 14, 1907, the feces failed to yield typhoid bacilli. During this time the patient's diet was carefully regulated and she was receiving mild laxatives. On October 16, 1907, a very thorough test showed that the germs were again present. From October 16, 1907, to February 5, 1908, weekly examinations of the stools gave, with only two exceptions, from 25 to 50 per cent typhoid-like colonies on the culture plates. These exceptions were on November 13 and December 4, when no typhoid was found.

The implication was plain. The cook was virtually a living culture tube in which the germs of typhoid multiplied and from which they escaped in the movements from her bowels. When at toilet her hands became soiled, perhaps unconsciously and invisibly so. When she prepared a meal, the germs were washed and rubbed from her fingers into the food. No housekeeper ever gave me to understand that Mary was a particularly clean cook.

In the Oyster Bay outbreak, which was studied with more particularity than the others, the infectious matter is believed to have been carried from the cook's hands to the people who were later taken sick by means of ice cream containing cut-up peaches. Mary prepared this herself. In this instance no heat sterilized the washings from her hands.

Mary Mallon was kept virtually a prisoner by the Department of Health for three years. At first she was held at the hospital for contagious diseases at the foot of East 16th Street, Manhattan; later she was removed to Riverside Hospital on North Brother's Island in the East River, between Hell Gate and Long Island Sound. She was employed in various ways, sometimes as laundress. She was allowed to receive friends and enjoyed such privileges as were possible, but she never became reconciled to her detention.

Two legal actions were brought to secure her release. The claims made on her behalf were that she was being deprived of her liberty without ever having committed a crime or knowingly having done injury to any persons or property; she was held without being given a hearing; she was apparently under life sentence; it was contrary to the Constitution of the United States to hold her under the circumstances; such action on the part of the authorities was without precedent. These legal actions were argued with much ability. It was expected that, if she won, she would recover heavy damages.

The case attracted a great deal of public notice, some of the newspapers going to the extent of printing the arguments with illustrations of the unfortunate woman. The courts held that the Department of Health acted within its rights in keeping Mary Mallon in custody and that they were well serving the public interests in refusing to release her.

Public sentiment, to judge by the illustrations, was a trifle mixed. On the one hand Mary was pictured as frying deadly typhoid bacilli the size of sausages in preparation for the family meal, and on the other she was shown sitting lone and dejected on her island with a mongrel dog as her solitary companion. *Punch*, the famous English funny paper, devoted a column of poetry to the case.

HER DISAPPEARANCE AND REDISCOVERY

Although the courts refused to order her release, there was a good deal of sympathy for Typhoid Mary. Whatever could be said of the consequences of her cooking, she had been an innocent offender. She was careless in her personal habits, but so are most cooks. If she was a deadly germ producer, so were thousands of others who were enjoying their liberty. To many persons who did not know Mary it seemed that she ought to be given her liberty.

In the year 1910, soon after a change was made in the administrative head of the Department of Health, Mary Mallon was voluntarily released on her promise not to take employment as a cook nor engage in an occupation which would bring her in contact with food. It was thought that she had learned in three years how dangerous she was and how to avoid infecting people. She was forbidden to cook or otherwise handle the food of others and was required to report periodically to the Department of Health.

For awhile she kept her promise. Then she broke her parole and disappeared. She was lost sight of for nearly five years. I have been unable to learn her complete history during this period, but from the fragments which have been collected, it is apparent that she continued to enact her fateful rôle of typhoid producer. Due to the fact that the woman assumed various names and left little trace behind to indicate her whereabouts, it was not possible to learn all that was desired.

She seems to have produced two cases of typhoid in a sanatorium at New Foundland, N. J., where she was employed in 1914, and another case in New York City in the same year in a small family where she was living under an assumed name with a friend. This, however, is anticipating the end of the story.

Mary Mallon came to light for the second time under circumstances which were the most dramatic of her entire career.

In January and February, 1915, an outbreak of typhoid occurred in the Sloane Hospital for Women on West 59th Street, New York City. In this epidemic there were twenty-five cases; they were mostly among the nurses and other attendants of the institution. The Sloane Hospital is one of the most capably managed institutions of its kind in America, and in its attention to every sanitary requirement is intended to be a model for the teaching of students in the College of Physicians and

Surgeons of which it is practically a part. In his conduct of the hospital and in his lectures to his students, it was the custom of Dr. Edwin B. Cragin, Attending Obstetrician and Gynecologist, to lay his main emphasis upon scrupulous care of the hands. Yet, as Dr. Cragin freely acknowledged, this outbreak was produced by a woman whose hands became soiled with her excrement and who through careless and dirty habits infected the food of the inmates of the institution. Whether she at first used sufficient care and later became indifferent is not known, but it is an interesting fact that Mary worked as cook in the hospital for about three months before the first case occurred.

She knew, of course, the danger and how to avoid it. She knew that she was violating her agreement with the Department of Health in engaging in the occupation of cook. That she took chances both with the lives of other people and with her own prospect for liberty and that she did this deliberately and in a hospital where the risk of detection and severe punishment were particularly great, argues a mental attitude which is difficult to explain. Aside from such behavior as this, Mary Mallon appears to be an unusually intelligent woman. She writes an excellent hand, and the composition of her letters leaves little room for criticism.

She possesses enough skill as a cook to command high wages and has been able to obtain work in the most desirable situations. Surely a mysterious, non-communicative, self-reliant, abundantly courageous person; a character apart, by nature and by circumstance, strangely chosen to bear the burden of a great lesson to the world. If she had learned and been willing to practice what she learned, she would not have had this costly lesson to teach.

Mary Mallon was officially known in the hospital by the name of Mrs. Brown, but she was jokingly nicknamed "Typhoid Mary" by her fellow-servants when the epidemic occurred, for there were some who remembered the published accounts of Mary Mallon's unfortunate experience of years ago. It was this nickname, applied in jest, that led the authorities to find her out.

When genuine suspicion began to focus upon her, Mary cleverly disappeared. Before she could be apprehended, she moved to New Jersey and then to a home in Long Island. She was finally traced to the Long Island house and was forcibly removed to the Riverside Hospital of the New York City Department of Health, refusing to go there without compulsion. She has been held by the Department of Health to June, 1919, without any prospect of again being released.

HER LESSON TO CIVILIZATION

Mary's status after her second arrest has been totally different from that which she possessed after her first. This is true both as to the legal

aspects and public sympathy. Whatever rights she once possessed as the innocent victim of an infected condition, precisely like that of hundreds of others who were free, were now lost. She was now a woman who could not claim innocence. She was known wilfully and deliberately to have taken desperate chances with human life, and this against the specific instructions of the Health Department. She had been treated fairly; she had been given her liberty and was out on parole. She had abused her privilege; she had broken her parole. She was a dangerous character and must be treated accordingly.

The total number of outbreaks of which Typhoid Mary is known to be the cause is ten; the total number of cases, fifty-one. Owing to the fact that only parts of her entire history are known, it is probable that the total number of outbreaks for which she is responsible is much larger than this record indicates. It would surprise nobody to learn that she had produced some extensive epidemics.

The case of Mary Mallon is of exceptional interest for a number of reasons. For one thing it illustrates one of the ways in which typhoid and other diseases may be spread without the real cause being suspected. It also shows that we should be slow in arriving at an opinion as to the origin of an outbreak.

It shows how carefully we should select our cooks, and it calls attention in a startling manner to the fact that we ordinarily know very little about them. It confirms the truth of the adage that the more we pay the less we know about our servants.

The Mallon case affords a striking proof of the fact that our food is not infrequently contaminated by excrement. Here lies, perhaps, a common source of infection. Possibly many of the so-called diarrheas and food poisonings which occur may be ascribed to this cause. Some persons and some families seem to be especially prone to these upsets. Is it not possible that what appears to be special susceptibility is really infection from a nearby carrier in many of these instances?

The story of Typhoid Mary indicates how difficult it is to teach infected people to guard against infecting others. Mary had ample opportunity to know the danger which she constituted toward those whose food she prepared. She knew from being told and she knew by experience. She was aware of the penalty which she would suffer if she broke her parole and caused another outbreak. That she could have avoided spreading infection by obeying her instructions admits of no doubt. She knew that when she cooked she killed people, and yet she deliberately sought employment as a cook in a hospital. Why did she do this?

The case is least remarkable for the reason that it was the first of its kind to be worked out in America. It is surprising that nobody had discovered a carrier before. They are now known to be rather common.

Somewhat similar investigations had been made in Germany, and I make no claim of originality or for any other credit in her discovery. My interest and experience in the epidemiology of typhoid had been of long standing. I had read the address which Koch had delivered before the Kaiser Wilhelm's Akademie, November 28, 1902, and his investigation into the prevalence of typhoid at Trier,[3] and thought it was one of the most illuminating of documents. In fact it had been the basis of much of the epidemic work with which I had been connected.

Koch's address was not the only one printed about this time to show that healthy carriers might exist and give rise to typhoid. Conradi and Drigalski[4] had anticipated Koch and it was probably on the suggestion contained in their paper to the effect that with their new culture medium they had found typhoid bacilli in the stools of several well persons that Koch's flying laboratory was sent to Trier and the ground prepared for his Kaiser Wilhelm's Akademic address.

In the Festschrift Zum Sechzigsten Geburstag von Robert Koch, which appeared in 1903, there are several papers on the probable rôle of healthly carriers in producing typhoid. About this time Kayser, Klinger and others were publishing in Arbeiten aus dem Kaiserlichen Gesundheitsmate reports of cases which they found to be due to persons whose condition was much like Typhoid Mary's. Dr. Simon Flexner kindly called my attention to some of these references after I had concluded my work on the Mary Mallon case.

The literature of carriers has enormously increased in all countries since 1906. Instances of carriers causing large and small epidemics have multiplied by the score. The extent of the danger which is to be apprehended from this source and the steps to be taken to meet it have been discussed pro and con until it would seem that the grounds for a common agreement must long since have been reached.

There is agreement as to nearly everything except how to cure the carrier condition. In some cases the germ focus can be reached and removed, in other cases this has so far proved impossible. The trend of thought has entirely changed as to the cause of typhoid fever. Before the rôle of carriers was suspected, water supplies and milk were considered the principal means of transmission. The carrier idea led many to think that here was the principal explanation of the spread of typhoid.

The present thought is that carriers account for a varying proportion of the total typhoid in a region, the exact figure depending largely upon local circumstances. Where water supplies, milk and other common

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[3] Die Bekampfung des Typhus—Veroffentlichungen aus dem Gebiete des Militar-Sanitatswessens, 21 Berlin, 1903.

[4] Zeitschr. f. Hyg. und Infect. 39, 1902, pp. 281–300.

vehicles of typhoid can be satisfactorily excluded from the reckoning, carriers probably account for most of the cases.

As a result of research work done in Europe and America, it has been found that from 2 to 3 per cent of all persons who have typhoid fever become chronic germ producers. Carriers have been divided into many classes and groups: some are intermittent, others continuous. A certain proportion permanently free themselves from infection and consequently their power to produce typhoid. Others never become free.

It has thus far been feasible to cure some of the carriers of their unfortunate condition, but there are others who cannot be cured. Experiments at disinfection and even the removal of the gall-bladder, which is generally the focus of the bacteria, have sometimes failed to produce the desired result.

What is to be done in order to protect ourselves from the danger of typhoid carriers? First, it is desirable to discover the carriers. This is not easy. It is most readily done with the help of a good laboratory. The examination of the feces should be made over and over again. Second, carriers must be told of their condition. They must be taught to use precautions against soiling the hands with the excretions. They must be taught to wash their hands frequently: always after leaving the toilet and always before handling food; they must never handle the food of others and they must try to give up the senseless habit of shaking hands.

We should all be careful to avoid eating uncooked food which has come in contact with the hands of persons whose history is not known to us and who may have contaminated the food immediately before our getting it.

Those of us who have had typhoid fever should be examined to determine whether we are carriers. If we are carriers, our families should be inoculated against the particular strain of the typhoid germ which infects us and special precautions should be exercised against the transmission of the bacilli in the household.

DETAILED NOTICE OF THE OCTOBER MEETING AT ST. LOUIS, MISSOURI, WILL APPEAR IN AN EARLY ISSUE.

RESECTION OF HEAD OF FEMUR IN CERTAIN GUNSHOT WOUNDS OF THE HIP REGION

(Report of Two Cases)

By Major ROBERT B. PRATT and Captain JOHN F. PARK
Medical Corps, United States Army

THE surgery of the hip joint, including as it does the head of the femur, the upper fifth of the femur, the neighboring pelvic bones, the pelvic contents, and the great mass of musculo-tendinous and fascial tissues in this area, is as replete with serious and complicated problems as any approachable region of the body.

Two cases of serious gunshot wounds of the hip, both involving the head of the femur and acetabulum, have come to our attention, have been closely parallel in their courses, complications and indications for treatment, and in our opinion constitute valuable contributions in support of the surgical principles to be considered in all cases of pyogenic infections of this joint.

Case I. J. F. C., No. 3175171, Private, Co. D, 16th Inf. White; 21 years old. History negative previous to wound.

October 8, 1918: Sustained, in action, severe, multiple, penetrating gunshot wounds (shrapnel) of left abdomen, left hip and left foot.

October 13, 1918: Debridement and secondary closure at an evacuation hospital.

December 17, 1918: A little over two months after injury he was admitted to U. S. A. Base Hospital No. 216. His general condition was serious. There were emaciation, pallor and flushed cheeks, relaxed skin, persistently large pupils, dry, red tongue, prostration, despondence, anorexia, insomnia, septic type of temperature, and pulse ranging from 110 to 120; respiration normal; heart and lungs negative. The abdominal wound was healed and the intraperitoneal state was apparently negative. The right hip and right lower extremity, genitalia and ano-rectal region were negative. A sacral bed-sore, about three inches in diameter, and a pressure ulcer from Thomas splint, over left ischial spine, were present.

Left hip and left lower extremity: A Thomas splint was in position, but was ineffective owing to the ischial sore. There were multiple sinuses about the hip, bordered with edematous, unhealthy scar tissue, and exuding large amounts of pus containing non-hemolytic streptococci and staphylococci; no anaerobic organisms. There was wasting of the buttock and atrophy of the entire limb. The skin was in poor condition from continued adhesive traction dressing. There was a superficial healing wound over outer side of leg.

X-ray examination showed a compound, comminuted fracture of the head of the femur and acetabulum, with infectious destructive process, and with new bone formation, not only at the joint, but in the muscle mass some distance away. Some atrophy of femoral shaft.

Urine examination and blood culture negative.

Blood count showed only moderate leucocytosis.

An attempt was made to lessen the infection about the hip by use of Dakin's fluid; to improve the sacral decubitus by half-turning him on to his right side; to improve his general condition by full feeding, iron, etc.; but without any notable result.

Operation.—January 17, 1919. Ether. Citrated blood transfusion (600 c.c.) during operation. Excision of one scar with its sinus, running from behind the anterior superior spine toward the great trochanter, this incision being continued to three inches below the great trochanter. Tissues freed about the entire circumference of the femoral shaft, just below the lesser trochanter. Gigli saw passed, and shaft sawed through at this point. Largest fragment grasped with iron-jawed forceps, cleared along its posterior border to the acetabulum, entirely freed, and removed. Two other fragmented portions of head and neck removed. Slight necrosis of acetabulum was found. This was thoroughly curetted away, to establish drainage from its inner surface. Medulla of upper end of shaft was abnormal but not purulent. It was curetted out for about one inch. Slight hemorrhage was controlled chiefly by packing, only one vessel requiring ligature. Time of operation and ether, twenty minutes. On account of sacral and ischial ulcers it was not thought advisable to attempt fixation by other means than sandbags.

Tetanus antitoxin (1,500 units) was given the day of and on the sixth and twelfth days after operation.

Pathological Report.—Microscopical description: Specimens consist of three pieces of bone tissue. No. 1 consists of head and portion of neck of femur. The head shows extensive necrosis of bone and almost complete absence of articular cartilage. The neck is fractured obliquely, and one portion attached to head. No. 2 consists of the great trochanter and external half of the shaft of femur as far as and including the lesser trochanter. This fragment shows exuberant callus formation. The medulla is soft, reddish-brown and semipultaceous. No. 3 consists of portion of inner half of shaft of femur and portion of attached neck.

Microscopical findings: (1) Section taken through head of femur. The articular surface shows some erosion and super-proliferation of young cartilaginous tissue. Diagnosis—healing arthritis. The cancellous portion of the head shows chronic inflammation. (2) Sections taken through the shaft near the lesser trochanter show acute inflammatory reaction. Diagnosis—acute osteomyelitis.

Progress.—His condition during the first night was very poor, and it is reasonable to believe that he would not have survived the operation in the absence of transfusion. General improvement began in a few days. Carrel-Dakin treatment was instituted on the fourth day after operation. On February 4, 1919, his pressure ulcers were healed and fixation of trunk and both lower extremities (the left in abduction) was gained by plaster cast. From then on his progress was very rapid. The right lower extremity was freed from the cast on the first of March, after which he was out of doors in a wheel chair on sunny days. He was evacuated to the United States on March 24, 1919, as a litter case, comparatively fat, of good color, with good appetite, and his wound practically healed. A new cast was in place, with the left lower extremity in abduction.

This patient received, for the purpose of dressing his wounds, about twenty administrations of anesthesia by Savariaud's method, of an average duration of six to eight minutes. In our opinion, our ability to discontinue

them contributed materially to improvement in his general condition—particularly to a reduction in pulse rate. Frequent urine examination failed to show evidence of postanesthetic acidosis.

Case II. E. M. H., Private, Co. 2, 147th Inf. White; 22 years old.

History negative previous to injury.

September 27, 1918: Sustained penetrating and perforating machine-gun bullet wound of left hip region, while in front line action. He received first aid.

October 2, 1918: "Infection present, drainage of joint by anterior incision. Diagnosis—pyemia; abscess of right hip, left hip, shoulder and sacrum. Bad condition. Abscesses opened posterior left thigh and anterior to left great trochanter, drainage and Dakin's. Voluntary bowel movements in bed, septic diarrhea, bed sores. Ready for evacuation Dec. 28, 1918, as Class D." (These notes from Field Records.)

January 10, 1919: About three and a half months after injury he was admitted to U. S. A. Base Hospital No. 216. His general condition was serious. There were extreme emaciation, facial appearance of profound sepsis, pallor of skin and mucous membranes, persistently large pupils, extreme irritability and depression, marked pain in left hip upon the least motion; septic diarrhea, with upward of ten to twelve movements per day, which, on account of the pain caused by any effort at getting on a bed-pan, he voided directly into the bed; anorexia, septic type of temperature, soft, quick pulse from 100 to 110, cough with purulent expectoration but without pulmonary signs beyond a few large bronchial rales; slightly extended abdomen, with thin, "scurfy" belly wall. Heart negative. Skin showed generalized scabies and pyodermia. Four extensive bed-sores over the sacrum, with exposure of bone. There was pressure necrosis over the left ischial spine and below the left anterior superior spine from a Thomas splint. A 4-inch scar in the adductor mass, with central sinus, and a scar running towards the great trochanter from below the anterior superior spine, with sinus, were present, with free discharge from both of pus showing non-hemolytic streptococci and staphylococci but without anaerobes. Marked induration about the hip and the upper third of the thigh. The scar tissue was "soggy" and very unhealthy. The calf of the left leg was nearly entirely gone, leaving a large unhealed ulcer. On both heels were areas of pressure necrosis. The skin elsewhere over the left lower extremity was in bad condition from adhesive, scabies and pyodermia. This patient presented as pitiful and distressing a picture as could be imagined.

Urine examination showed febrile albuminuria. Blood count showed moderate polymorphonuclear leucocytosis. Blood culture was negative. Sputum examination was negative.

X-ray Examination.—Infectious destructive process involving head of femur and acetabulum with comminuted fracture of latter.

In this case, also, general treatment and careful nursing were instituted to improve his condition, but without any definite result excepting in the status of his skin lesions. He required sedatives to afford him any sleep, his diarrhea kept him in a constantly filthy condition, he could be dressed only under anesthesia, his sepsis progressed. Maj. Chas. F. Nassau, M. C., Chief of Surgical Service, U. S. A. Base Hospital No. 38, who saw this patient in consultation with us, thought that hip joint amputation was indicated, but that he would not survive this formidable operation at one sitting, and recommended primary resection of the femoral head and subsequent completion of the amputation.

Operation.—January 13, 1919: Ether. Citrated blood transfusion (600 c.c.) during operation, without which it is almost certain this patient would have been lost. An incision was made beginning close to the anterior superior spine running towards the great trochanter, then down the outer side of thigh, to the bone, for about four inches below the great trochanter. The scar of the old incision and sinus was excised so far as possible. The femur was cleared in its entire circumference below the great trochanter and divided at this level with a Gigli saw. The upper fragment was grasped with lion-jawed forceps. The femoral head and neck were cleared by cutting attachments to the great trochanter and digital fossa, and following it to acetabulum along the posterior surface. The remainder of the neck and head was easily cleared and removed. The joint capsule could scarcely be identified. There was marked necrosis of the acetabulum and after thorough curettement, pus was found to have passed through its floor to its inner surface but apparently did not pass far in any direction from the acetabulum, nor beyond its medial musculo-fascial boundary. The medulla at the upper end of the shaft of the femur showed no gross change. Several infected and necrotic masses were removed from the tissues, the largst about 1½" x 2", composed of scar, muscle and fibro-cartilaginous material, partially infiltrated with lime salts. Hemorrhage was controlled by a few suture ligatures and packing with iodoform gauze. Time of operation, twenty minutes. Time of anaesthesia (including cast application), one hour and ten minutes.

A plaster cast was applied, including trunk, pelvis, both lower extremities, with the left in abduction, windows being cut at wounds and bed-sores. This was done in the half hope that fixation might be obtained for a short time at least. Three days later, however, it was necessary to remove this and trust to sandbags for support. Fixation by any other means was not possible.

Tetanus antitoxin (1,500 units) was given the day of and on the sixth and twelfth days after operation.

Pathological Report.—Microscopical appearance: Specimen consists of head, neck and that portion of shaft which is 1 cm. below great trochanter of femur. The head shows extensive erosion of the articular cartilage and slight necrosis of bone. The medulla of the shaft is grayish, with fiery red mottling.

Microscopical findings: (1) Section taken through head of femur. The articular cartilage shows extensive necrosis and has superimposed a layer of inflammatory exudate, composed of much fibrin, intermingled with a few polymorphonuclear leucocytes. The cancellous portion shows sub-acute and chronic inflammation. Diagnosis: Acute arthritis; sub-acute and chronic osteomyelitis. (2) Section taken from upper end of shaft of femur. Shows an acute osteomyelitis.

Progress.—His condition was grave for forty-eight hours. After the removal of the cast he was more comfortable. His appetite increased, sepsis lessened and he showed local and general improvement. Physiological rest had been so improved that, beginning a few days after resection, he slept without morphia or without craving for it. This is notable in view of his previous requirements in this hospital and his statements as to the frequency with which it had been administered previous to his admission here. It was still necessary to dress him under anesthesia. His diarrhea cleared up very rapidly. Inability, however, to fix the limb gave endless trouble. It was difficult to prevent pocketing at the site of operation because

of this flail joint in the position he sought for comfort. The wound in the adductor mass drained profusely at first but lessened some after the resection. A collection of pus formed on the outer side of the calf just below the knee and required drainage. His bed-sores healed reluctantly. He was afebrile, had gained in weight, was sleeping fairly well. Generally, he was much better; locally, his condition had come to a standstill, and it was decided to complete the amputation.

February 25, 1919: Ether. Citrated blood transfusion (600 c.c.). Femoral artery and vein exposed and ligated at apex of Scarpa's triangle. Thigh amputated by open flap (guillotine method) about three inches below great trochanter. Hemorrhage controlled by ligatures. Necrotic tissue removed. The sinus into upper end of adductor remnants in flap was laid open. Packing was inserted into acetabulum. Dressed.

Progress.—Reaction excellent. Packing removed on third day, and Carrel-Dakin installation begun. Streptococci still present. Progress has been uneventful to date, with the exception of one small collection of pus in a too rapidly closing inner edge of amputation wound. The bed-sores, relieved of pressure, healed completely. Immediate and marked gain of weight took place. His course has been afebrile to date.

On April 1, 1919, he was ready for return to the United States as a litter case, in excellent condition, with hip region healed excepting a small clean granulating area along line of incision.

This patient had anesthesia (Savariaud's method) about forty times without any obvious ill effects. Frequent urine examinations failed to show acidosis.

Discussion.—The future will bring up many questions of great importance to these two men—on the one hand, whether the new flail, probably later ankylosed, hip joint and shortened extremity will be useful; on the other hand, of an existence on crutches, or the possibility of an artificial limb. These questions are of minor importance with regard to the fact that the two men are living, and these questions must be utterly disregarded in the determination of that course of surgery which, in the pressure of the grave emergency, offers a chance of life.

Both cases emphasize the following surgical principles:

(*a*) Penetrating and perforating infected wounds are accomplished by the spread of infection along many unrestricted paths which follow no such well-defined course as do some of the hematogenous or lymphogenous infections of this area, and cannot be drained by any single incision.

(*b*) Chronic pyogenic processes involving both the head of the femur and the acetabulum cannot be properly drained excepting by resection of the femoral head.

(*c*) In all cases where resection is practised, the acetabulum should be thoroughly explored and, if necrotic, should be sufficiently removed to furnish ample drainage from its internal surface.

(*d*) Resection in the hands of only moderately experienced surgeons is a brief operation and eliminates a large amount of shock involved in hip joint amputation.

(*e*) Resection alone, however, is attended with certain shock, and this should be combatted with the prophylactic transfusion of citrated blood during the operation.

(*f*) Removal of the head is facilitated by first separating it from the shaft by Gigli saw (the easiest and most rapid method) and by clearing its trochanteric and posterior surface first.

(*g*) Completion of the hip joint amputation subsequent to resection is simple, rapid of performance, and in no comparison in severity with the entire formidable operation.

(*h*) Where comminution of the head is extensive, with considerable separation of fragments and sinuses leading to the skin surface, drainage is correspondingly greater, and in parallel cases microscopical examination will show less acute changes.

(*i*) The extensive, diffuse, new and unhealthy bone deposits which occur in and about an infected joint which is improperly drained and is without physiological rest.

(*j*) The absolute necessity for the simultaneous exhibition of proper drainage and proper fixation.

(*k*) The utter uselessness of Dakin's fluid without first following Carrel's injunction as to the proper surgical preparation of the wound.

We express our indebtedness to Maj. John W. Moore, M. C., in charge of Central Laboratory, Hospital Center, Nantes, for his pathological reports of specimens.

ANNUAL MEETING OF THE ASSOCIATION OF MILITARY SURGEONS, OCTOBER 13th to 15th, 1919, AT ST. LOUIS, MISSOURI. DO NOT FORGET IT.

ORDNANCE AND ITS EFFECTS

By Major CHESTER R. SNOW
Trench Artillery

(With eight illustrations)

THE term "Ordnance," in its broadest sense, includes nearly every tool and weapon used in fighting. Thus it embraces everything from the trench knife and war club through machine guns and grenades to the heaviest artillery weapons.

We will consider briefly each of the principal weapons now in use.

Trench knife and *war club* cannot be said to be new weapons, but at least the use of them is new to soldiers of the present generation. Their effect, and also that of the bayonet, is obvious, so that nothing further need be said of them.

The rifle is the principal weapon in modern warfare. The rifles of the different belligerents differ but slightly in appearance, size and mechanism and our own .30 caliber Springfield may be taken as typical of all. The bullet is of lead with a cupro-nickel jacket, weighing 150 grains, and has a muzzle velocity of 2,700 foot-seconds. The rifle is sighted for firing up to 2,500 yards, and at 45 degrees elevation it will carry as far as 5,400 yards, or a little over 3 miles. At 200 yards the bullet will penetrate 0.3 inch of steel plate, 60 inches of pine board or greasy clay, about 20 inches of loam, and 9 inches of dry sand. At 600 yards it will penetrate 12 inches of dry sand. This difference in the case of sand is due to the fact that at the shorter range the bullet is deformed by its excessive energy, and consequently its penetration is reduced. In all other substances the penetration is greater at the shorter ranges. On account of its great energy the bullet has great shocking power as well as penetration.

The *pistol* is a minor weapon in this war. The French officers provide themselves with such pistols as they choose and have calibers ranging from .32 to .45. A German pistol that I have seen was about a .41 caliber. Our army uses the .45 Colt automatic pistol or S. & W. revolver, using the same cartridge. The bullet is of lead, .45 inch in diameter, the outside being a cupro-nickel jacket. It has a muzzle velocity of 800 feet-seconds and at ordinary ranges at which a pistol is used it will penetrate 6 inches of pine. A one-inch penetration of pine is considered the equivalent of a severe wound. This pistol was designed to give a rapid fire and great shock effect. The .38-caliber revolver, which was abandoned for the .45, had a higher muzzle velocity and greater penetration, but not sufficient shock or stopping power. One incident, which

led to the change to the .45 caliber was the fact that in the Philippines an officer fired six shots from the .38 into a native who continued his rush and severely injured the officer with a bolo before dropping dead.

The sawed-off shotgun is in use in this war principally for trench cleaners. It is very effective up to 60 yards, and at these ranges is more effective than the rifle on account of the number of shot and their tearing effect.

Grenades may be classified as hand grenades and rifle grenades.

The hand grenades are of two principal types—the defensive and offensive grenades.

The defensive grenade is made with a heavy body checkered with lines of weakness to insure complete fragmentation, and it carries a heavy charge of high explosive. The fragments are killing up to 50 or 75 yards and dangerous up to 100 yards; hence the person throwing it must take cover in a trench or shell hole to avoid fragments of his own grenade.

The offensive grenade has a body of light tins and contains a large charge of high explosive. Its extreme killing radius is only 8 to 10 yards, the splinters of the light body being very small, and its blast effect is depended upon to do the damage.

Grenades are also filled with smoke compounds, and tear and poisonous gases. These grenades are used by the trench cleaners in clearing dugouts. It is evident that in a dugout a man may take shelter from the fragments of an explosive grenade by going to another compartment or taking cover, but the gas grenades will penetrate to every part, and the fillers of some are gases which, it is claimed, will penetrate the German gas mask. (British K. J. grenade.)

All modern hand grenades are ignited by a time fuse which lights the powder train as the grenade leaves the hand. The fuses are timed to burst the grenade five seconds later. Grenades may be thrown up to 35 yards, the distance depending upon the strength and skill of the thrower and the weight of the grenade.

Rifle grenades are similar to hand grenades but are propelled by using a rifle with a suitable attachment for holding the particular grenade. They may be fired by an ordinary cartridge or by a special blank cartridge, according to the particular model. Rifle grenades are filled with the same substance as hand grenades, and their effects are the same. The advantage is that their range is greater, being as high as 210 yards. The rifle from which they are fired is usually placed in a special frame, so that it may be given any desired elevation. We know that a man in a trench or shell hole cannot be reached by a rifle bullet. He can, however, be reached with a grenade which may be dropped into the trench, descending at a steep slope. I might add that a grenade is a very dangerous weapon and should be handled only by those who have special training in its use.

Automatic rifles differ from machine guns in being light enough to be easily used by one man. They can be fired by a man advancing, and the rate of fire is up to 60 shots a minute. They use the same cartridge as the regular rifle, and consequently their effect is the same.

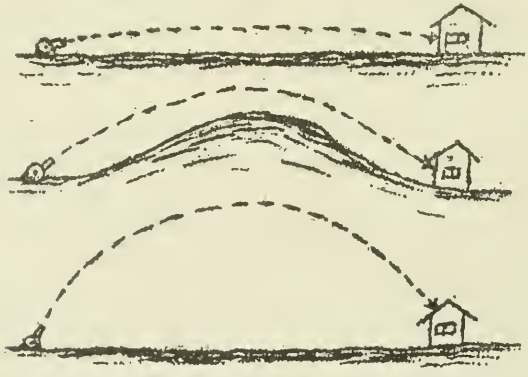
Machine guns can be fired up to a rate of 400 shots per minute, the rate being governed by the operator by adjusting the gas escape or the special mechanism, according to the model. They use the same cartridge as other small arms. In this war indirect fire for machine guns has been developed and, consequently, their use in barrage fire. When using indirect fire the machine guns are placed well to the rear of the target and fire at high angles. Consequently the slopes of fall are very steep, and overhead cover is needed for protection against it.

We next come to the weapons of the artilleryman, or what is termed ordnance within the most common meaning of the word.

The artilleryman's weapon consists essentially of the tube or barrel, the carriage on which it is mounted for firing, the explosive used both as a propellant and as a bursting charge for the projectile, and the projectile.

The barrel of the gun is very interesting in itself in the ingenious methods used to make it withstand great internal pressures, but time will not permit us to consider its construction.

The carriage has two purposes, to take up the recoil and to direct the fire. This second purpose only concerns us. We classify fire into three kinds according to its use, namely: direct fire, where the gun is fired at angles up to 15 degrees; curved fire, when the projectile departs at angles between 15 and 45 degrees; and high angle fire, when the angle of departure is between 45 and 90 degrees. Guns designed especially for curved fire are called howitzers, although in the present war all guns are mounted so that they can be fired at angles up to 45 degrees.



Guns designed for high angle fire are called mortars. The needs for these classes of fire are readily seen. Suppose we have a target which is greater in dimension vertically than horizontally, as the walls of a building. Direct fire is the most useful.

Suppose we must fire over a high hill or a woods. Obviously curved fire is called for, while if the target presents greater vulnerability on top than on the sides, as the top of a building or shelter, we need high angle fire. The kind of carriage provides for this.

The subject of propellants leads us to consider explosives. An explosive is a solid or a liquid which can be readily converted to a gas. An explosive consists essentially of a combustible substance, as carbon, and an oxygen producer as a nitrate or chlorate.

Explosives are divided into three classes: (1) Powders or propellants; (2) detonating explosives; and (3) detonators.

Powders or propellants burn in the same manner as wood or coal, only, having their oxygen contained within them, they burn at a much greater rate, and this rate increases with the temperature and pressure under which combustion takes place. Keep in mind for the moment that it is simple combustion, and then we can contrast them with the second class, detonating explosives or high explosives. In these we do not have combustion, but rather an instantaneous disruption of the force which binds together the atoms in the molecule, which causes the atoms to depart from their present comparatively unstable combinations as nitrates or chlorates and form more stable ones as carbon dioxide and nitric oxide, and others, according to the composition of the explosives. This class of explosives is used in blasting and as shell fillers.

The next class is the detonating explosive, which is characterized by mercury fulminate. Explosives of this class are not only of a higher order of detonation than those of the second class but they have the power of initiating detonation, or the disruption of the molecular bond in explosives of the second class. Take, for example, trinitrotoluene, a high explosive and a most common shell filler. If we ignite it with a match in the open it will melt and slowly burn. If we light it when confined it will burn more quickly, but will cause an explosion only as the gases accumulate from the rather rapid combustion. But if we explode some mercury fulminate in contact with it, we immediately obtain a detonation of the whole mass.

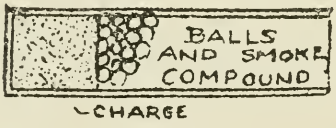
High explosives have individual characteristics, and their utilization as shell fillers is governed accordingly. Picric acid, for example, is comparatively insensitive, but very quick and of great disruptive power. It, or some of its compounds, is the almost universal filler for high velocity shells. The speed of these explosives is such that it tends to disrupt rather than remove material. On the other hand, certain chlorate explosives have 50 per cent more power of removing earth than the picrates. They are used more for the destruction of dugouts, but their great sensitiveness limits the use to shells of low velocity.

Projectiles as regards their effect may be classified as follows:

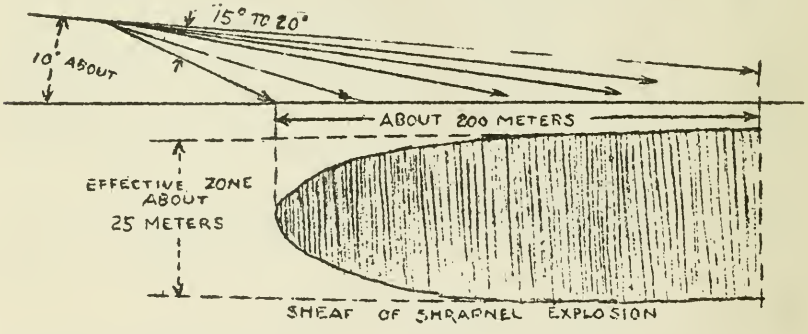
1. Shrapnel

2. High Explosive Shell. { Air, or time fuse bursts. { With instantaneous fuse. / With non-delay action fuse. / With delay action fuse. } Ground or percussion fuse bursts. }

The shrapnel consists of a case with a charge in the base and the rest of the case filled up with balls of lead or iron about an inch in diameter, and the interstices filled with a smoke-producing compound, which is useful to show the point of burst in order that the fire may be adjusted.



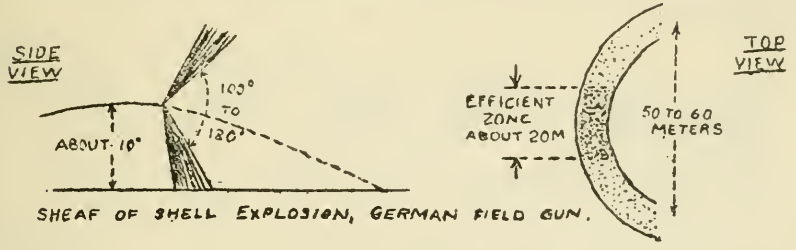
Shrapnel is used mostly in guns of about 3-inch caliber, as the French 75 and the German 77, and such a shell will contain about 260 of these balls. The head of the shrapnel holds a combination time and percussion fuse, the time fuse being an arrangement by which the interior charge is ignited a certain length of time after the projectile starts and causes the balls to be projected forward. The percussion element of the combination fuses detonates upon hitting the ground in case the shrapnel does not burst in the air. The effect of shrapnel is to sweep a cone-



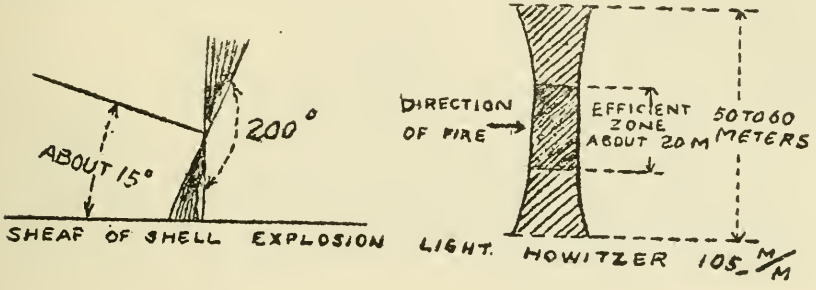
shaped area, the area varying in size with the height of the burst, the higher the burst the more area covered and consequently the thinner pattern made by the 261 balls. The penetration of the individual balls is slight, 10 cm. of earth giving protection, and shrapnel is of slight use against troops under cover. However, it may be effectively used against troops in open trenches by enfilading the trench or by bursting the shrapnel at such a point in the trajectory that the cone of dispersion will be directed downward.

High explosive shells, equipped with a time fuse, are fired from both field guns and howitzers. The field gun is a high velocity cannon having

a flat trajectory. A shell, from the German 77 for example, bursting in the air will give a cone of dispersion of the form shown, the direction given to the fragments being the resultant of the forward movement of the shell, and the lateral motion imparted by the bursting charge.



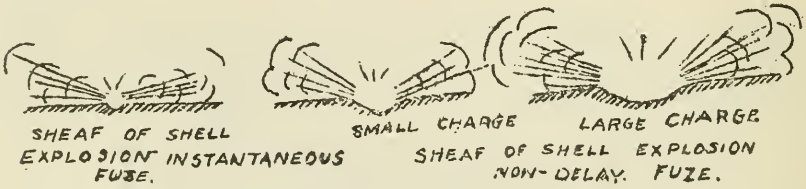
The howitzer uses curved fire and low velocities. Therefore, the air burst of a shell fired from a howitzer, the German 105 for example, will give a somewhat different dispersion of the fragments, throwing some directly downward and to the rear. The rearward motion of the fragments is due in part to the steep slope of fall of the projectile and to its low velocity.



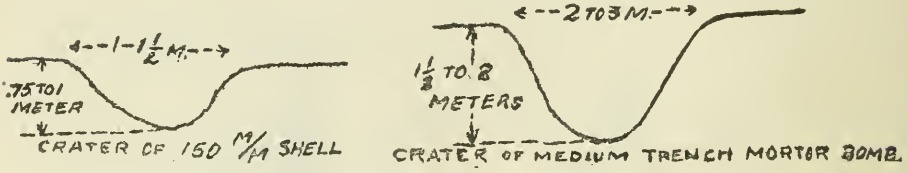
The thing to note in regard to these shells is the fact that while a trench may give cover against the 77 H. S. shell, overhead cover is essential for protection against the shells fired from howitzers. The fragments from these shells are very numerous and very irregular in shape, and at first are propelled with great speed, which they rapidly lose. The penetration of the fragments is not great, except close to the point of burst.

The high explosive shell with a percussion fuse will give three effects according to whether an instantaneous, a slight delay action (say 1/25th second) or a long delay action (say 1/6th second) fuse is used. The instantaneous fuse, as its name indicates, detonates the projectile the instant it strikes the ground. It makes very little, if any, crater, and the fragments are projected horizontally in all directions, making a very destructive projectile against personnel or wire entanglements. The slight delay fuse or non-delay fuse makes but a small crater—say from

6 inches to a foot deep—and sends part of its fragments and the material from the crater upward and downward at varying angles, depending upon the depth it has penetrated and the strength of the explosion. We may have craters like this with the resultant flight of debris and fragments.



The H. E. shell, with the long-delay action fuse, is used against shelters and dugouts, the idea being that it shall not detonate until it has penetrated the ground a considerable distance. An ordinary 6-inch shell with delay action in soft soil makes a crater about 1½ meters across the top and about 1 meter deep. A 58-mm. trench mortar bomb will make a crater 2 or 3 meters in diameter and about 2 meters deep.



In some cases a shell will penetrate the ground so far that the explosive contained in it has not sufficient power to raise the earth above it. In this case we have what is called a camuflet. Such a burst near a dugout is very destructive.

One case I have observed is interesting in connection with protection fuse shells. You will notice that most all old soldiers drop very quickly to the ground when a shell is heard approaching. The value of this is proven. A shell dropped 40 feet from a group of men without cover; six of them were hit by fragments, two being killed instantly and three severely wounded, but in no case was one of them hit less than 24 inches above the ground. One man still nearer to the shell heard it coming and dropped to the ground. He was not hit. The evidence shows that had all the men dropped instantly to the ground none would have been hurt.

This shell was about 105-mm. caliber. It had a very quick fuse and made a crater only about 9 inches deep and 24 inches in diameter. Some fragments were about 2 cubic inches in size.

So much for the effect of the shells themselves. The destruction done by the shells will be influenced by the way in which they are used, and this has changed in a very marked manner from that of previous wars. These changes may be considered as:

1. The greater proportion of guns of large caliber in use.
2. The greater number of guns of all calibers in use and the consequent prolonged and violent artillery activity.
3. The use of barrage fire, which is made possible by the great number of guns.

The great number of guns and the large assortment of calibers, with ranges varying up to 38,000 meters, have enabled the guns to be distributed in depth. Consequently, on a given length of front, many more guns may be used than formerly, and targets at a greater distance behind the lines may be reached. The use of a greater number of guns of all calibers has enabled the density of fire to be increased. More enemy guns must be put out of action before one side remains with a marked superiority of artillery. The long ranges of the guns enables them to have a greater choice of positions from which to fire, and consequently more time is required to search them out and neutralize them.

The great density of fire permits the use of the barrage or curtain of fire, which is made by all guns, including machine guns, being directed upon points so that the whole makes an impassable barrier. When a barrage is put down the bulk of the fire is directed at trench junctions, communication trenches and roads where the enemy would most probably try to pass.

These points of dense fire can be learned by observation, and one can use this information to advantage should it be necessary to attempt a passage through a barrage.

STRUCTURE AND SYSTEMATIC RELATIONSHIPS OF THE "IODINE CYSTS" FROM HUMAN FECES[1]

By Major CHARLES ATWOOD KOFOID, *Sanitary Corps, U. S. Army;* 2d Lieutenant SIDNEY I. KORNHAUSER, *Sanitary Corps, U. S. Army;* and OLIVE SWEZY, Ph.D.

(With twenty-five illustrations)

THE recent literature dealing with infections of the human digestive tract by Protozoa contains references to a problematical organism designated, because of its iodophylic inclusions, as the "Iodine Cyst." It occurs in human feces and has been reported repeatedly by several investigators in Great Britain as occurring in course of routine examinations of stools of hospital patients and others. The precise nature of this problematical organism and its systematic affinities appear thus far to remain in obscurity. Furthermore the accounts and figures of its structure are somewhat incomplete and leave the reader in doubt as to the content of the term.

In the course of a review of the literature and an examination of over 2,500 stools of soldiers of the U. S. Army, we have reached the conclusion that these problematical organisms include, primarily, a larger race of *Endamoeba nana* than has hitherto been recognized, with the probability that an undescribed yeast-like organism has also been included therein by Wenyon and O'Connor.

The first reference to these puzzling organisms is that of Thomson and Thomson (1916), who recognized them as "peculiar bodies of probably protozoan nature found in the stools of dysentery patients." They deal with a variety of structures of organic origin, including what appear to be polymorphic leucocytes, fragments of amebas, degenerating amebas, and, in their figures 1 to 3, typical representatives of the large race of *Endamoeba nana.* They give no name to these structures and do not assign them to *Endamoeba.*

Notice was again independently drawn to these peculiar cysts by Wenyon (1915*b*), who, in an appendix to a republished earlier paper (1915*a*), writes as follows:

> In addition to the organisms found so frequently in the human intestine there has appeared in the feces of some of the cases from Gallipoli a spherical body, which is usually smaller but may be equal in size to the cysts of *Entamoeba histolytica.* It is probably of a vegetable nature and, in feces kept for some time, there is an indication that it elongates and may reproduce by simple division, or even grow into filaments or hyphae. It may thus be the spore of a fungus, but its importance is that it can be mistaken, especially when it is large, for the cysts of the pathogenic *Entamoeba.* It

[1] From the U. S. Army Laboratory, Port of Embarkation, New York City, Maj. E. H. Schorer in charge.

is shown in the photomicrographs 7 and 8 of the plate. Each cyst has a single nucleus which is much smaller than the single nucleus of the single nuclear stage of *E. histolytica* cyst. In addition to the nucleus which appears in the fresh condition as a small granular ring there are one or more refractile bodies of varying size which again bear some resemblance to the chromidial bodies seen in the cysts of *E. histolytica*. These bodies are strongly iodophylic and in preparations of feces made with Weigert's iodine solution they become a dark brown, almost mahogany color, as shown in the photomicrographs 7 and 8. The iodophylic body or bodies are often much larger and more irregularly shaped than shown in the plate.

Somewhat more than a year later Wenyon and O'Connor (1917*a*, p. 355; 1917*b*, p. 83) gave in greater detail an account of these "Iodine Cysts," together with six figures (their Plate 3, Figs. 12–17) of the organisms, as follows:

During the early months of the year these peculiar structures, with their strongly iodophylic bodies, were frequently met with in the stools. They were present sometimes in very large numbers and it is interesting to note that the most intense infections were met with amongst a series of native prisoners we examined in Hadra prison. They were present in 14.8 per cent of the prisoners.

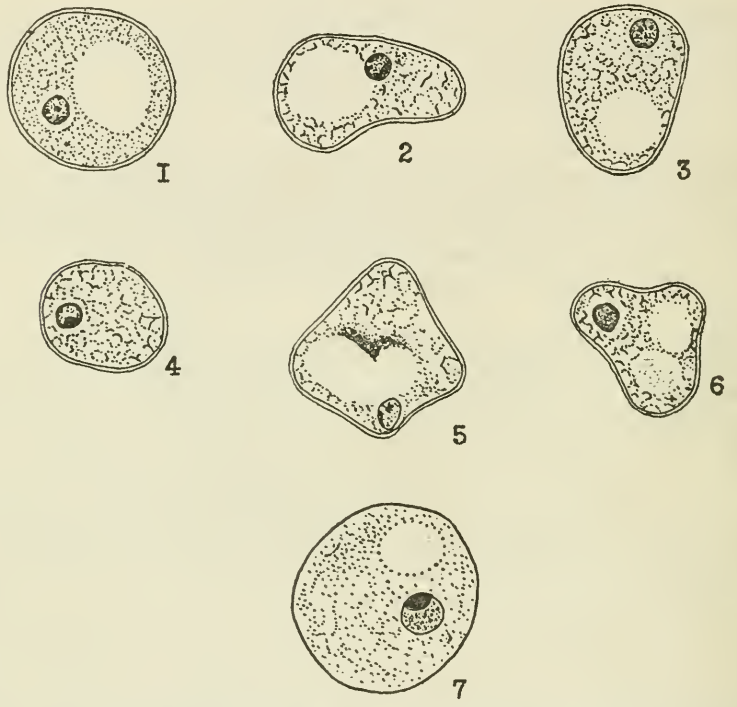
Examinations of the daily rations microscopically did not reveal any source of infection.

The "Iodine Cysts" are generally easily recognized if one employs iodine. Sometimes without this it is difficult to identify them certainly, as the iodophylic body may be mistaken for the chromidial body of a cyst of *E. histolytica*. The iodophylic body, however, tends to be rounded or lobed, while chromidial bodies in the *E. histolytica* cysts are generally rodlike. The "Iodine Cysts" vary greatly in size and shape. They may be quite small with a diameter of 7 or 8 microns, or large with a diameter of 15 microns or more. Though most usually they tend to be circular or oval in outline they may be lobed or show processes which suggest an outgrowth into a filament. The single nucleus is smaller than the nucleus in the single-nuclear *E. histolytica* cyst, and furthermore it is different in appearance and structure. In one or two cases we have come across fairly large infections of cystic structures which resemble the "Iodine Cysts" in every way except for the absence of the iodophylic body. These caused us a good deal of difficulty as there was a decided resemblance to *E. histolytica* cysts. After careful observation of the cases it was possible to make up one's mind that these were really "Iodine Cysts" minus the iodophylic bodies. In typical "Iodine Cysts" infections, where the majority of the cysts have the characteristic iodophylic bodies, a few may be seen in which these are absent (Plate 3, Fig. 15).

In one or two cases there have occurred in the stool larger spherical cysts which look very much like cysts of *E. coli* with a single nucleus, which is a spherical body with a thick nuclear membrane, while the central part is clear and unoccupied by granules or other structures. It has the appearance of a homogeneous body with a central vacuole. When first seen it was thought the cysts were peculiar forms of the cysts of *E. coli*, but by following the cases for a few days it was found that there was no tendency for recognizable stages of *E. coli* cysts to appear. It was evident that they were not amebic cysts. It seems most probable that they represent large "Iodine Cysts" which are devoid of iodophylic bodies or structures of an allied nature. One such case as this was seen by one of us during the routine examinations in London of patients returning from Gallipoli at the end of 1915.

In this same paper Wenyon and O'Connor described *Endamoeba nana* t make no reference in the text to the presence of iodophylic bodies

therein, either in free ameba or in cysts. Nor do such bodies appear in their figures of the cysts, though the large vacuoles present in two of their figures of free amebas (their Plate 1, Figs. 14, 15), plainly of sluggish rounded up forms such as appear in stools along with encysted stages, may well have been occupied by the glycogen body, or iodophylic body of Wenyon and O'Connor. Furthermore, in their description of *E. nana* they give 7 to 8 microns as the diameter of the spherical cysts



[Figs. 1–6.—"Iodine Cysts" from stained material. After Wenyon and O'Conner (1917, Plate 3, Figs. 12–17). The iodophylic body appears as a vacuole. Fig. 4 shows a cyst without iodophylic body. The cysts measure 7 to 10 microns.
Fig. 7.—"Iodine Cyst" after Matthews (1918, Plate 1, Fig. 24).

and 8 to 10 microns as the length of the elongated cysts, while the "Iodine Cysts" are stated to range from 7 to 15 microns.

In their helpful and critical review of the three common intestinal endamebas of man, Dobell and Jepps (1917) note the occurrence sometimes in *E. nana* of the mass of substance colored dark brown by iodine and identify it as glycogen. Their figures do not show its occurrence or relative size, with the exception of that of one cyst in which the glycogen vacuole is indistinctly indicated. They also extend the upper dimensions of the species to 12 microns.

In a later paper Matthews (1918) briefly refers to these cysts, adopt-

ing with reference thereto much the same position as Wenyon and O'Connor (1917*b*, pp. 83–84), as follows:

> These cysts were first noted by Wenyon (1915) and have been more fully described by Wenyon and O'Connor (1917). They vary greatly in size, covering practically the same range in size as the cysts of *E. histolytica*, and it is with these that they are likely to be confused. This is particularly the case when the structures are examined in saline. The iodophylic body which is most characteristic of "Iodine Cysts" may simulate the chromatoid body of an *E. histolytica* cyst, though it is generally not rod-shaped but rounded or lobed. In iodine this inclusion stains deep brown and has well-defined edges. Occasionally "Iodine Cysts" are found without the iodophylic body, and it is then that the organism may very closely resemble a cyst of *E. histolytica*. The nucleus is, however, distinctly smaller than the nucleus of a uninucleate *E. histolytica* cyst, and is quite different in structure (see Fig. 24 and compare with Figs. 1, 2, and 5). (Fig. 24 was drawn from fixed material stained with iron hematoxylin. The iodophylic body shows as a clear space, but in a cyst mounted in iodine this space would appear dark brown in color and the nuclear structure would be less clearly defined.) It should also be noted that small "Iodine Cysts" may be confused with *E. nana* or *Tetramitus* cysts when these contain, as they sometimes do deeply staining glycogen vacuoles. "Iodine Cysts" are not protozoal. They probably represent some stage in the life history of a vegetable organism but, so far, all attempts to cultivate them have failed.

Matthew's figure (our Fig. 7) of the "Iodine Cyst" is indistinguishable in our opinion from a large mononucleate *Endamoeba nana*. It has a small nucleus with the same nuclear structure with peripheral chromatin plaque on the nuclear membrane, and empty glycogen vacuole. It is perhaps significant that Matthews notes that small "Iodine Cysts" may be confused with *E. nana* or *Tetramitus* cysts when these contain deeply staining glycogen vacuoles, and also that he gives no criterions by means of which they may be distinguished from *E. nana*. He makes no mention of spherical cysts with a single clear, spherical "nucleus" without central granule such as Wenyon and O'Connor include in their "Iodine Cyst." It thus seems probable that the "Iodine Cyst" of Matthews consists solely of large mononucleate *Endamoeba nana*.

In 1917 Beaurepaire Aragoa introduced the term "pseudo-cysts of *Endamoeba histolytica*" applying this designation to the cysts described by Schaudinn for *E. histolytica*. These bodies are not, however, any phase of the "Iodine Cyst" of Wenyon and O'Connor as the terminology might lead one to expect, but are, according to Beaurepaire Aragoa the small secondary cysts of *Blastocystis* which he believes Schaudinn mistook for the cysts of the dysenteric ameba.

One infers from the review of Kuenen and Schwellengrebel (1917), the original of which has not been available, and from Kuenen (1918) that the iodine cysts of these authors are the large mononucleate *Endamoeba nana* only. The dimensions (9–13 microns), the brown-staining "iodine body," the cap-like chromatin mass of the nucleus and the chromatoidal grains in the cytoplasm, are all characteristics of *Enda-*

moeba nana. These authors apply the name *Pseudo-limax* to these organisms, but, in the literature at hand, without specific designation. They found the organisms in two persons from India and Java respectively.

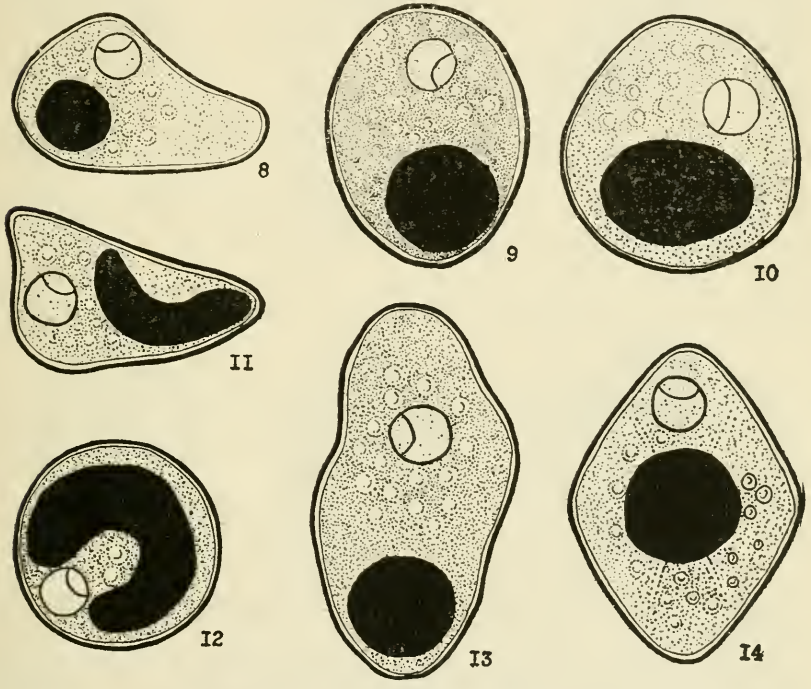
Brug (1919) describes the ameboid stage of the Iodine Cysts, notes the excentric location of the chromatin mass but states that this is not directly on the membrane, as we find it, as a rule, in *Endamoeba nana.* Vacuoles containing bacteria or detritus occur in the cytoplasm, which is, however, a feature characteristic of *E. nana.* The "Iodine Cyst" stage is round or oval, 8 to 12 microns in diameter, with a homogeneous corpuscle which is not a "chromidium" like that of *E. dysenteriae* in shape, and stains a dark brown in iodine stain. Cysts are mononucleate, rarely binucleate. Brug concludes that the iodine cysts are phases of *Endolimax williamsi,* not referring to the species described by Wenyon and O'Conner as *Endamoeba nana.* The species known as *Endamoeba williamsi* Prowazek has usually been regarded as merely an aberrant form of *E. coli,* a view with which, after a review of the literature and of Brug's data and figures, we are in agreement. The nuclear conditions described by Brug in his "Iodine Cysts" appear to be closer to those of *Endamoeba nana* than to those of *E. williamsi* and *E. coli,* and are perhaps not irreconcilable with the nuclear conditions in *E. nana* in some phases. We therefore dissent from Brug's conclusion that the "Iodine Cysts" are *Endolimax williamsi,* especially in view of the lack of critical knowledge and good figures showing the range in form and nuclear conditions in this so-called species, and in view of the absence of a full discussion by Brug of the claims of *E. nana* as including the "Iodine Cysts."

From our own observations on human protistal infections we have come to the conclusion that the "Iodine Cyst" of Wenyon and O'Connor (1917 *a* and *b*) is a complex of two organisms including, first, the large mononucleate race, usually glycogen-bearing, of *Endamoeba nana,* and second, a hitherto undescribed phycomycete occurring in small numbers in the stools of many different individuals. The latter is their "large spherical cysts which look very much like cysts of *E. coli.*"

Our grounds for these conclusions are as follows: Under certain unknown conditions the cysts of human intestinal amebas and also those of the flagellate *Chilomastix mesnili* present, accumulated within their cytoplasm, considerable quantities of glycogen which stains a deep brown in iodine, and dissolves out in water, leaving, when compact, an empty vacuole in fixed material. In *Endamoeba coli* this is most evident and most frequently found in the large binucleate cysts where it occupies a central position, fills the central half or more of the cyst, and crowds the two nuclei peripherally. Its shape is subspherical or squarish with rounded angles, and is often indented by the two nuclei. Its

margins are rather sharply defined and usually merge with a slight haziness into the enclosing cytoplasm. In the still rarer four-nucleate cysts the glycogen mass is smaller, more diffuse or entirely lacking, while in the prevalent eight-nucleate and very rare sixteen-nucleate cysts the glycogen seems to have entirely disappeared.

The glycogen mass in *Endamoeba dysenteriae* is either diffused throughout the cytoplasm or gathered in diffusedly margined clouds. It occurs in races of all sizes but tends to be most frequently present and in largest amounts in the largest races. It is also found in the one-, two-, and four-nucleate cysts but, in our records, is found in only about 50 per cent of the last named as compared with 57 per cent of the mononucleate ones.

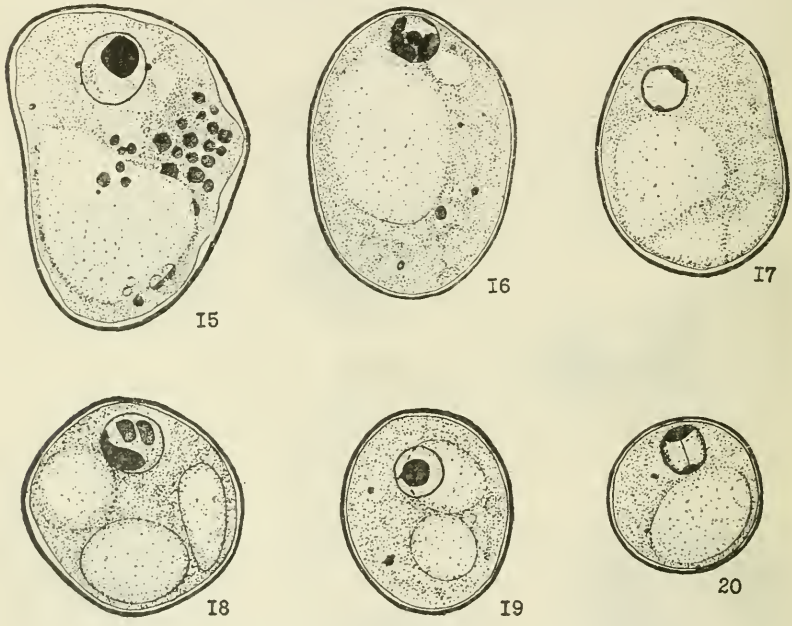


FIGS. 8–14.—*Endamoeba nana* from material stained with iodine-eosin stain. The iodophylic body or glycogen mass appears as a dark body. The cyst walls are shown as black lines. Note the irregular outlines of the cysts. X 2600.

In *Endamoeba nana* the glycogen mass is much more frequently found than in the other two common intestinal amebas, is of greater relative volume than in *E. dysenteriae*, is much denser, stains much more deeply, and has a very sharply marked periphery, not merging gradually into the surrounding cytoplasm as in the case of the other two species. It therefore leaves a very sharply defined vacuole in stained preparations in which the glycogen has been dissolved out by the water of the

solutions used. This appears clearly in our figures which represent *E. nana* in iodine-eosin stain with the glycogen mass in black (Figs. 8–14) and in iron haematoxylin preparations in which the glycogen mass has been removed by solution, leaving a clear vacuole (Figs. 15–20).

The glycogen mass is more frequently found in individuals of *E. nana* than in either of the other intestinal amebas. It is also relatively larger and more abundant in the large mononucleate cysts than in the smaller cysts. In fact two nuclei are rarely found in these larger cysts and, as yet, we have not found four in them. It seems probable that there may be a decrease in size of the cysts as the glycogen decreases



FIGS. 15–20.—*Endamoeba nana* from material stained with iron hematoxylin. The glycogen appears as a clear vacuole. Note the irregular distribution of chromatin in the nucleus of figures 15–18. X 2600.

in volume and as the nuclei increase from two to four. The smaller cysts sometimes have only a very small, very dark sphere remaining, and a few only lack all trace of the glycogen.

There is thus in all three of the intestinal amebas a general tendency for the glycogen mass to be larger, and to be present more frequently in the earlier stages of the cyst, namely, in the one- and two-nucleate stages than in the later terminal ones with four, eight or sixteen nuclei. This phenomenon is apparently one of the depletion of reserve food supply stored up in the cytoplasm of the encysting organism as glycogen, and exhausted as mitosis proceeds and the cyst ages. The initial stages of this process in *Endamoeba nana*, when the glycogen is at its maximum,

are the largest observed stages of the species and have the largest glycogen masses. The excentric inclusion of the relatively large glycogen mass tends to give to these stages a lack of uniformity in shape and a tendency for enlargement towards one end. These features also appear in Wenyon and O'Connor's figures (our Figs. 1–6) of their "Iodine Cysts" and afford evidence that these are the large mononucleate phases of *Endamoeba nana*.

Another line of evidence supporting this conclusion as to the identity of "Iodine Cysts" and *E. nana* is found in the nuclear structure. In our material (Figs. 8–20) the nucleus in these large, glycogen-laden cysts which we believe to be the "Iodine Cysts" is invariably of the *Endamoeba nana* type in the following particulars: In the first place the nucleus is relatively smaller than in *E. dysenteriae*. In smaller stages, 7 to 10 microns, such as Wenyon and O'Connor figure, the nucleus is from 1.5 to 2 microns. In their figures the diameters of the nuclei appear to run about 1.25 to 1.5 microns. They give dimensions of their cysts as 7 to 10 microns, but not their magnifications. In our larger cysts of 10 to 18 microns in longest diameter, the diameter of the spherical nucleus ranges from 2.5 in the smaller cysts to 4 microns in the largest ones and is generally about 3 microns. In the "Iodine Cyst" figured by Matthews (1917) the diameter of the cyst is 11.5 microns and of the nucleus, 2.5 microns (Fig. 7). The nuclear dimensions in the "Iodine Cysts" are thus comparable with those of *E. nana* which exhibits these nuclear dimensions.

In the second place the position of the nucleus is excentric, rather close to the periphery, or midway between the center and the periphery in the "Iodine Cysts," as also in *E. nana*, as reference to the figures will show.

In the third place the structure of the nucleus is that of *E. nana*. This is true in all of our material critically examined on this point, of the "Iodine Cyst" of Matthews (1917), but clearly so of only one cyst in Wenyon and O'Connor's figures (1917 *a* and *b*), namely, his Fig. 15, reproduced in our Fig. 4. This nuclear structure is characterized by the accumulation of the chromatin on one side of the spherical nucleus in a circular plaque, sometimes in several detached, irregular masses. In a few instances a rod from the center of the plaque crosses the nucleus to the opposite side to terminate on the membrane in a knoblike expansion. These resemble telophases of mitosis, the rod being the centrodesmose. The types of nuclei shown in Wenyon and O'Conner's figures are varied. Their Fig. 15 (our Fig. 4) is of the *E. nana* type commonly found, with a single large plaque. The nuclei in their other five figures all depart somewhat widely from the typical condition. Scattered local encrustations are shown in Fig. 13 (our Fig. 2), extended encrustation in Fig. 17 (our Fig. 6), and only small, local granules in Figs. 12, 14, and 16 (our

Figs. 1, 3, and 5). These are not irreconcilable with nuclear conditions occasionally seen in glycogen-bearing *Endamoeba nana*, as will be seen on comparison with our Figs. 16 and 18. They are, however, not typical of that species. On the other hand, the nucleus in the single figure of Matthews (1917, pl. 1, Fig. 24, our Fig. 7) is typical of *E. nana*.

In the fourth place the nuclear membrane in *Endamoeba nana* and that of the single nucleus in the glycogen-laden "Iodine Cysts" is of the identical delicate, non-chromatin encrusted type except at the region of chromatin aggregation. It is detected with some difficulty even under the oil immersion, except in rare instances, when the centrodesmose is present and mitosis is pending or recently passed. At such times there is some chromatin on the nuclear membrane.

Additional evidence for the identity of *Endamoeba nana* and "Iodine Cysts" is found in the intergradation of the two in the matter of the size and volume of the glycogen mass. In extreme cases in the largest cysts it constitutes 0.3–0.5 of the total volume, and in smaller cysts may sometimes exceed 0.7. From such extremes all gradations exist down to the complete elimination of all localized iodine-staining glycogen. There is no line of demarkation between the two unless all glycogen-laden cysts are excluded from *Endamoeba nana*. Furthermore, it is possible to note the decrease in the volume of the glycogen masses in cysts in stools kept and examined daily for several days. In the stool from which the cysts in our figure were taken, the average diameter of the spheroidal mass in 20 cysts taken at random from the stool on the first day was 6.9 microns, with a range of 4.9 to 9.0 microns. On the second day the dimensions were 6.5 (4.9 to 8.1) microns, and on the third day 5.1 (4.5 to 6.7) microns, a decrease of 6 and 26 per cent respectively in the volume of the glycogen mass as the cysts aged during the three days.

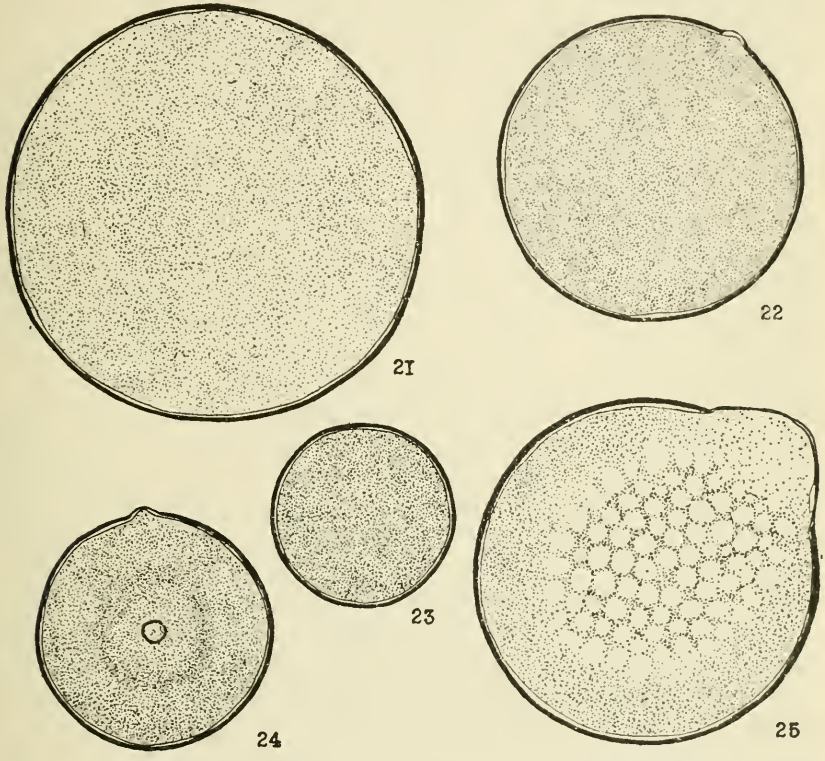
In view of the evidences there appears to be no tenable alternative to the conclusion that the glycogen-laden cysts called "Iodine Cysts" by Wenyon and O'Connor and by Matthews are only the early phases of encystment of the several size races of *Endamoeba nana* in which the store of reserve food is at or near its maximum volume.

HOMOGENEOUS BODY WITH CENTRAL VACUOLE

It appears that Wenyon and O'Connor's account (1917) of the "Iodine Cyst" includes a reference to a cyst much like those of *Endamoeba coli* with a single nucleus. These are homogeneous with a central, spherical, nucleus-like vacuole without nuclear contents. They conclude that the structures are Iodine Cysts without iodophylic bodies. They report two cases of the occurrence of these bodies in stools.

In the course of 2,685 examinations of stools we have met with 190 instances of infection with cysts which we have referred to the "homo-

geneous body" of Wenyon and O'Connor. Not all, in fact very few, have the central vacuole, but those with the central vacuole appear to belong to the same category as those without, differing from them only in the presence of the vacuole. As Wenyon and O'Connor state, these homogeneous cysts are very much like those of *E. coli*, at least in normal salt or iodine-eosin stain. Their range in size, 10 to 30 microns, their smooth, spherical contour, their definite cyst wall of width and refractive index not unlike those of cysts of amebas, and their color are sug-



Figs. 21–25.—"Homogeneous Body" as seen in material stained with iodine-eosin stain. Figs. 21–25 show undifferentiated character of the cytoplasm. Central vacuole appears in Fig. 24, and vacuolization of the cytoplasm in 25. The opening through the cyst wall appears in 22 and 24 and is greatly enlarged in Fig. 25. X 2600 except Fig. 25, which is 2300.

gestive of amebic cysts, but close inspection at once reveals differences. They never contain iodophylic glycogen masses, but are notable for the homogeneity of their contents. They range in size from 10 to 30 microns, as a rule, though we have found instances of cysts 7 microns in diameter. Measurements of 20 cysts in 19 cases of infection gave an average of 15.5 microns and a range of 10 to 24 microns. In shape they are quite regularly spherical, lacking the slight divergencies from that form which characterize *Endamoeba nana* as a rule, *E. coli* less

frequently, and *E. dysenteriae* in still fewer instances, except in the smaller races.

The cyst wall is smooth, regular, and similar to that of *E. coli*, only rarely somewhat heavier. There is one point on certain cysts, possibly in many of them, for we have found it in several cases on search but not in others, where there is an interruption in the wall and a thin-walled, low protrusion projects beyond the periphery (Figs. 22, 25). There may be only a slight flattening at this point. The protrusion is suggestive of the initial stages of budding in yeasts, and the flattened surface may be the place of detachment of a daughter organism, or of the cyst or spore from a hyphal cell or filament or the initial stage of a hypha.

The contents of the cyst have the refractive appearance of protoplasm, considerable firmness, and a remarkable homogeneity. In many instances in physiological salt solution they have a greyish olive-green or greenish-brown color. In iodine-eosin stain they resist the eosin for a long time as do cysts of *Endamoeba*, but in some cases are soon tinged with the iodine. In the greater proportion of the cysts the contents are uniformly homogeneous throughout, showing no trace of structural differentiation. In a few instances only (Fig. 24) have we seen the empty, spherical, central vacuole noted by Wenyon and O'Connor (1917). In one case two such vacuoles were seen and in a third a small vacuole was seen in the periphery. In a number of cysts the central part may show faint shadows of spheroidal vacuoles and in others the central region is definitely alveolar (Fig. 25) suggestive of the absorption of water and the initial stages of budding or of hyphal outgrowth. In no instance has a definite nucleus been found.

They are never abundant and frequently only a single cyst has been recorded. Their numbers are never greatly increased by concentration methods, and they apparently do not float off in ether-centrifuge concentrations. The nature of their occurrence is such that they appear to represent a widespread but individually sparse infection of the human digestive tract. The possibility that they are undigested spores of adventitious origin from contaminated food or water is not precluded. However, the absence of any instances of heavy contamination seems to militate against such a source.

The systematic relationships of this organism or of these organisms, for there may be several species represented, are wholly problematical. No records of such infections have been found in the literature of the organisms of human or other feces. Their structure is suggestive of a chlamydospore of some phycomycete or the resting phase of some yeast. Isolation and culture are essential to determine their systematic position and affinities.

The suggestion of Flu (1919) that "Iodine Cysts" are degenerative phases of "tetragena" cysts does not appear to be tenable either, for

"tetragena" or for any other organism, in the sense that either of the organisms included in the concept of "Iodine Cysts" are *per se* degenerative individuals of other species. The large mononucleate *Endamoeba nana*, which constitute the iodophylic group, have normal cytoplasm and nuclei in fresh stools. Evidences of general cytoplasmic deterioration and nuclear disintegration are absent, at least in approximately the proportion of individuals which are normal in other phases of the species. In one case of a stool with excessively large cysts, signs of degeneration appeared in these cysts on standing for three days. The shapes and number of nuclei suggest that the process of encystment has not progressed in these large cysts to the same degree that it has in the smaller cysts of *Endamoeba nana* in the stools at the time discharge. In stained smears individual cysts in various phases of degeneration may be found in all stages of this and other species of *Endamoeba*, but in such instances the degeneration appears to affect many individuals at once in various phases of their cycle, and not merely the larger or the mononucleate stages. In other words there is no evidence that large glycogen-laden cysts of *Endamoeba nana* are degenerating because of these characteristics, though some of them doubtless do degenerate because encystment is not far advanced when the stool is discharged.

The homogeneous cysts likewise show no unmistakable evidence of degeneration. Their optical properties, resistance to stains, and uniformity of structure are apparently those of normal organisms. Their occurrence and distribution are those of a widely distributed but relatively rare organism of the human digestive tract. They were never abundant in any of the 190 instances in which we found them in stools. At the most not more than several cysts were found in a single direct smear. They occurred independently of all the other protist parasites and in nearly all available combinations with them, but without predominance or limitations to indicate that they are a degenerative phase of any one of the organisms with which they are associated.

There is no clinical evidence in cases of pure infections by *Endamoeba nana* or by the homogeneous cysts that they are pathogenic.

SUMMARY

The "Iodine Cysts" of human feces described by Wenyon and O'Connor include two different organisms, namely, the large glycogen-laden, iodophylic, mononucleate cysts of *Endamoeba nana* and the non-nucleated, homogeneous, spore-like cysts of some vegetable organism, possibly the chlamydospore of some phycomycete of unknown affinities.

The nucleated "Iodine Cysts" intergrade in diameter, and in size of the glycogen body with the smaller bi- and quadrinucleate cysts of *Endamoeba nana*. The size of their nuclei is the same as that of the large mononucleate *E. nana*. The location, finer structure, distribution

of the chromatin, and nuclear membrane of the nuclei of the "Iodine Cysts" are similar to those of *Endamoeba nana.*

The "Iodine Cysts" resemble the cysts of *E. nana* in structural details more than they do those of *Endolimax williamsi* Prowazek, a doubtful species allied to *Endamoeba coli.* Brug's conclusions that they are phases of that species are not sustained. Flu's conclusion that they are degenerate "tetragena" cysts is likewise untenable.

The homogeneous cysts included by Wenyon and O'Connor in their "Iodine Cysts," have no nuclei and only rarely one or more excentric or central, empty, nuclear-like vacuoles. Their cytoplasm is homogeneous, with alveolar vacuolations appearing in some cysts with process-like protrusions of cytoplasm. They range in size from 7 to 30 microns and were found in small numbers in 190 cases in 2,865 stool examinations, or in 7 per cent. They may be the chlamydospores of a phycomycete of unknown relationships.

There is no satisfactory evidence that the "Iodine Cysts" are *per se* degenerative phases of any amoeba or other organism, or that the homogeneous cyst is an adventitious parasite. Both appear in their distribution and occurrence to be normal parasites, but without indications of pathogenicity.

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A LECTURE ON FIELD HOSPITALS

By Colonel BAILEY K. ASHFORD
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(*Concluded*)

NOW we come to the *French* army.

We had seen a few of their field ambulances and I am afraid we made a snap shot diagnosis that they were behind the British; we were still under the influence of the English at that time very strongly. The first one who talked about them was Professor Tuffier. Now Professor Tuffier is a very remarkable man and all of us know him by reputation. He is a civil surgeon of a very fine type, speaks English very well by the way; a man who is a very patriotic Frenchman; and at great personal loss he has done much in this war; he has been throughout the war one of the chief—if not the chief—of the consulting heads in the Department of the Service de Santé. Everyone has looked up to him a great deal. He told us that all the field ambulances of the French army used to be known as the *hopitaux de triage*. Gentlemen, I am going to say something here today that is going to be directly contrary to what you have heard some division surgeons advise from their experience in Chateau-Thierry. I don't think there is any question but that the early difficulties of the Medical Department of the French army came largely from their early application of the triage. Now war is a very disorderly sort of thing, and to try to carry it out by any fixed rules, to try to produce ideal conditions at any cost, makes ideally impossible conditions ideally wrong conditions. The French field ambulance was established in the immediate rear of the fighting troops—3 or 4 kilometers, too near to be a field hospital—established there as a triage or sorting place for all the wounded, sick, and gassed sent there to be classified. From that place, of course, these men, being classified, were sent to the various points which were specialized for treatment of certain classes of cases. But what actually happened. If you want to see what actually happened, go to the Val de Grace Museum in Paris and look at that exceedingly fine painting of a triage. It is a work of art, a beautiful thing; and there in the gathering darkness, just about as day was dying, with the wounded lying on stretchers out over the ground in every direction, one or two tense doctors and nurses were going around with lanterns peering into the faces of the men to see what they had. What's the result? It's a block interposed in a main path to the rear without being able to remedy the condition. That's not the way to do triage. The French found that out and stopped it.

That kind of a triage means this: A man comes in wounded from the front. His battalion surgeon has dressed him and he would know more about him than anybody else, and he should put a diagnosis ofwhat he believes he has on the usual tag. That will do to get the man back to the hospital where he can be treated properly. I have seen diagnoses such as this: "Compound fracture of the femur with probable injury to one of the principal vessels." That's enough. If that man stops anywhere on the way back they will look at it to see if he has been bleeding, but he ought to be sent direct by the battalion surgeon to where he can get proper treatment and that's what the French do today. A formal triage which stops every man and makes him wait until he has been examined or only to have his tag read, without being able to apply a remedy, is courting disaster. Now this is the triage that we don't want to do in the American Army; it is the kind we are starting in to do, but it is a fatal mistake. You shouldn't do triage at any one place; you should do triage at all places but only by reference to his diagnosis tag. Send the man in as fast as you can to get him to some place where he can have something done for him. There is a place where by far the most important triage is done, and that place is the advance surgical hospital for non-transportable cases and that is a field hospital. Tuffier said "make that hospital a 200-bed hospital with one surgeon and four assistants." Certainly 3 or 4 kilometers is too close to the line; it should be 10. Now at these places, of course, you treat shock, hemorrhages, and all that sort of thing. You have to have a radiologist; no reason at all why you shouldn't.

Here are a few notes from General Ruotte. General Ruotte was chief surgeon of the French army at Gallipoli. He says there are two ambulances to a division, two to a corps, and an indeterminate number to an army for reinforcement. The old French ambulance used to be an animal-drawn affair with seven wagons; there were five surgeons, one pharmacist, one administrative officer, eight drivers and thirty-eight enlisted men. That has been found not to be well enough equipped, so they added to it the new surgical automobile ambulance, which is what they call the *auto chir.* You hear of that a great deal and it is known in our army as the mobile hospital unit. They send it up and make of it a modern field hospital, with ten surgeons, ten assistant surgeons, eight nurses, sixteen enlisted men and the consulting surgeon with four surgical sections. They have a portable operating, radiologic and sterilizing outfit, on five trucks. He said that one field ambulance was to be used for the non-transportable wounded and one for the sick and triage.

Some time ago we went up to the 6th Army. This was a very interesting trip because our class had seen the 4th Army and wanted to see the 6th, and the 4th and 6th Armies were the ones the Germans

broke through a few days after we got out. That was the break which took the boches down to Chateau-Thierry. Beaurieux was one of the prettiest villages I have seen. Very old, quite romantic, fine chateau, and all that sort of thing, and in the basement of that chateau was the field hospital, or rather the field hospital and the advanced surgical hospital. We had a talk with General Laznet, a young man, chief surgeon of the 6th Army; very active; like General Ruotte, always out in front somewhere—that's where we found him. He said his idea was to put one field ambulance per division as a triage as near as possible to the line and incorporate with it an advanced surgical team with equipment. He manned this advanced surgical hospital with the best surgeon he could get, a crew of female nurses, provided it with fifteen to fifty beds, and saved at least some lives. General Laznet was getting down to what is about right. I never saw better outfits than they had. No private hospital in Paris had much of anything on them—spring beds, spotless linen, central heating, electric light and solid comfort. All of this 7 or 8 kilometers from the front.

We went to Vailly. That town was pretty well smashed up, but they had a beautiful hospital in the bowels of the earth—just like Beaurieux and 7 kilometers from the line. From there some of us went to a famous stone quarry where they had one of these field ambulances and an advanced surgical group. This place was quoted as being the ideal advanced surgical hospital, right under the guns of the enemy. It was very near the line, in a quarry with 20-feet protection of solid rock. They had everything they needed; heat, light, and perfect equipment; and while they had only fifteen beds the place would hold an indefinite number of men.

We went back a little further and saw another advance surgical hospital that was in a depression on a height 8 to 10 kilometers from the front. This hospital had a gas quarter and two Bessonneau tents. There was a good resuscitation ward. They kept all gas cases and the non-transportable.

Now, mind you, these were field hospitals, so called; they preserved the name field ambulance, but in reality they were advance evacuation hospitals, and this was the first echelon of the new French scheme of having their evacuation in three lines. They run about 15 kilometers apart. That is the best way—no question about it, it is the best. In the second echelon is the field hospital of the corps, or the evacuation hospital.

We now reached this second echelon Evacuation Hospital, the H. O. E. (*Hôpital Origine Evacuation*) de Corps. This was a large unit holding a thousand. There were four Bessonneau hangars which held 250 gassed and 250 wounded. One hangar was filled with the non-evacuable and there was here an eye and ear department. The rest were housed

in small Bessonneaus. This was formed by a group of field ambulances of the corps.

We now reached the group of field hospitals for medical cases. This was one of six such groups for the 6th Army and was the chief one. It was well in the rear, in the grounds and buildings of a fine chateau, near Soissons. In fact all their field hospitals for medical cases seemed well in the rear. The chateau buildings were surrounded by Service de Santé barracks. This group was the headquarters of the Consulting Physician of the Army, the Medical Disability Board and the Army Laboratory. In addition, in an isolated section of the grounds, was a hospital for contagious diseases of some 250 beds. It was an army unit, although composed of field ambulances.

On one occasion we visited a group of three French field ambulances for seriously wounded on the Aisne and near the line. It was in a chateau reinforced by many barracks. The part was very attractive and no expense or trouble had been spared to make it thoroughly comfortable and ornate and to provide the soldier with every necessity. It was in command of the Consulting Surgeon of the Army, M. Okinczyc, the exponent of advanced surgical hospitals. This one was shelled at times and on one occasion five surgeons had been killed there outright by one shell. The operating group with its *groupe complémentaire de chirurgie* (our mobile surgical unit) was lodged in barracks, painted white interiorly, with plenty of electric light, ample central heating, city operating room, furniture, etc. There was an elaborate shock room with electric light canvas hoods for warming patients and windows therein through which the patient could be observed and through which an arm could be protruded for transfusion while the heating went on. The radiologic room was complete. They had an X-ray operating table and outfit, with a fluoroscopic operating bonnet, and a perfect sterilization plant. The hospitalization section was neatness, cleanliness and comfort itself—linoleum on the floor, iron bunks well made up, with sheets and blankets, walls painted (they were decorated in all these hospitals), flowers on the table, nurses in attendance. One of the wards was kept for streptococcus cases, all of which were isolated. There was a good pathological and bacteriologic laboratory. There was here a triage and evacuation section. Only seriously wounded were held here as a rule, and it was a true field hospital—the first echelon surgical hospital of the French. By contrast with this excellent group in which the wounded were lodged in chateau and barrack buildings we cite Chalons-sur-Vesle, in many respects the most complete and best administered field hospital group we have ever seen. The site was excellent, in a large chateau in a wooded park, on a good road and only 5 kilometers from the front. Here the patients were housed in tents; the operating equipment in a chateau and in a couple of barracks. This

operating equipment was a *groupe complementaire de chirurgie* on truck and tractor, and as the operating was done in the chateau the portable operation pavilion was used exclusively for radiology. The electric lighting of the hospital was from this *groupe* and it yielded 150 32-candle-power lights. Here there were three operating rooms and three sterilizing rooms. These were all white enameled, centrally heated, and well equipped. Nine operating teams worked here, each composed of one surgeon, one assistant and three enlisted men. There was a triage here at this hospital and from the receiving rooms operative cases were sent to the pre-operating room or to shock room as indicated. There was one medical officer detached to care for the shock and pre-operating room, and he did nothing else.

The evacuation section was in Bessonneau tents and one Bessonneau hangar and had a capacity of 1,000. It was really extraordinary the amount of equipment they had lavished on these wards and their cleanliness and cheeriness.

There was also a remarkably fine gas quarter here. It had its own triage, and chlorine cases were sent to the wards direct, the mustard gas cases to the bathing pavilion. This bathing and degassing outfit consisted of the following apartments in a partitioned barrack for: (1) Derobing, (2) bathing, (3) alkaline solution to mucous membranes, (4) fresh clothing, (5) history taking, (6) ward.

This field hospital group only took gassed and the severely wounded. Its capacity was from 500 to 1,500 as needed.

Division Medical Field Ambulance.—This was run by M. Collin, a French medical officer who had been for a long time a regimental surgeon under Colonel Thoris, whose work you know, and he had shown us on a previous visit what we shall always remember as the finest regimental station we have seen to date. This hospital was also in a chateau with a large wooded park on a hill which was filled with barrack wards. Its capacity was 300 and it received sick, skin diseases, and the gassed. It, too, was a model of neatness, lavish equipment and furnishings.

Divisional Medical Field Ambulance.—There was a little field hospital, a divisional affair, that was devoted to the treatment of medical cases at Jouaigne. Beautifully situated, it was as pretty a country as I have seen. That hilly country invaded by the Germans is very, very beautiful; and this little hospital was in a chateau in a park, very comfortable, and devoted to medical cases. Its capacity was 400. It was installed in barracks and in the chateau itself. I was told there that they divided their cases into the slightly ill, not to be kept more than six days; the cases of incipient tuberculosis, and into other contagious diseases. I found out that this was the first place to which men suspected of tuberculosis came, and they had a radiologic outfit for medical diagnosis of these cases and heart cases. The tubercular never return to the front.

The closed cases are sent to work in the rear, somewhere in the base sections, and the open cases are sent to sanatoria. They had a section devoted to the treatment of the ordinary diseases, and the chief ones seen at that time were influenza and its dependent complications. At that time they were having an epidemic of "three-day fever" (influenza) and they had some very serious cases of pneumonia and pleurisy. Near this hospital was a rest station for officers in a large chateau, a perfect beauty, where they had all the comforts of home and a luxurious home at that. We found both English and French here.

The Division Field Ambulances near Pont à Mousson.—One was for slightly wounded and sick and the other for seriously wounded with a *groupe complementaire de chirurgie* attached. The latter was in a large seminary and was most excellent. The other was in barracks. In addition a special army surgical hospital of 320 beds was provided for overflow and serious cases. It was of Service de Santé barracks and was also a good example of comfort and completeness. There was a section of this hospital devoted to the ambrine treatment of the burned.

Group of Field Ambulances for Gassed and Slightly Wounded.—This was in a cantonment area, a rest area. It had a Bessonneau hangar for sitters, a barrack hospital and a complete operating group with sterilizing, radiologic and pre-operating wards.

Field Hospital in Rheims.—This was only 2 kilometers from the German trenches and was sheltered in old wine cellars under a municipal hospital. It accommodated 60 patients, but while excellent in equipment and neatness it was very near the lines and in time of bombardment was cut off. It was a triage and advanced surgical hospital, but the disadvantages of having a triage so near the lines and in an out-of-the-way corner of a ruined city seemed very clear to us. Time was wasted in getting to it that might have been better employed by sending the wounded direct to the rear.

Fracture Hospital.—This was also in a fine chateau on a wooded hill which was well parked and full of flowers. The wounded were in Service de Santé barracks. While every city hospital accommodation was provided under beautiful country surroundings and it was neat, clean and well equipped, it was too far from the line and all cases arrived infected. Its capacity was 400.

Visit to the Chalons Sector.—Here the field hospitals were, as in the 6th Army, frankly grouped as evacuation hospitals. They were, however, still referred to as "field ambulance groups." One, 10 kilometers from the front, was fully immobilized in Service de Santé barracks and had a specially constructed operating group. It was an orderly and complete a barrack hospital as one could wish to see, and a feature of the place was its landscape gardening and comfort, even its luxury. Its capacity was 1,000 and it received the gassed and the severely wounded.

They had female nurses, the usual triage, an exceptionally good de-shocking plant and operating teams.

The last field hospital I have to call your attention to was at Jouchery. This is destined to be a historic site for military and civil surgeons, for it was here in this little barrack hospital that Lemaitre, the father of the primary suture, bravely worked out under surgical conditions, without radiology or bacteriology to help him, in the face of almost insuperable obstacles, the greatest contribution of surgery to war. It should not be forgotten that it was not in a base hospital, nor even a big evacuation hospital, that this great light to surgical practice was kindled. It was in a modest, even poor, little field hospital within gunfire of the enemy, and it was done by a man who was a plain field hospital man who had never advanced any claim to being a great civil surgeon. The hospital, when we visited it, was a tiny affair compared to the splendid big institution we had just seen. It was complete and neat, of wooden barracks on three sides of a court, in the center of which was a Bessonneau tent for the triage, dressing room, pre-operating room, and shock room. At this date all of the progress of military surgery was represented—a radiologic room, bacteriological laboratory, etc., but it reminded me of a toy hospital. It bespoke its poverty, but it was clean, cheery and ornate. I was accompanied by Lemaitre himself, who, though promoted to a professorship in the French Medical School with a huge operating clinic at the H. O. E. of Bouleuse, preserved for it an affection and enthusiasm which was very touching. He exclaimed as we approached, "That is the ideal. Give me a little place like this and my devoted little band of assistants that stuck loyally to me all through the early days of the primary suture, and, all alone off here, I can do more than if I had the biggest institution in the French Army." There was something very human about this that appealed strongly to me. The big things are often done in these small, poorly equipped places.

At that time M. Okinczyc was in command. He had been transferred here from the hospital where we had first seen him. The personnel was 5 medical officers, 1 radiologist, 1 administrator, 1 pharmacist, 42 enlisted men, and 15 drivers. No feature of an evacuation hospital was missing; its capacity was 400. There were two operating rooms. The slightly wounded are classified here as donors for transfusion, but, with this exception only, the seriously wounded are brought here.

Major Okinczyc assembled our student officers in the receiving tent and gave us a short talk on the work of a field hospital in war. It was short, but I believe that it synthetized all that can be laid down as doctrine for the surgical use of field hospitals from the professional standpoint. The field hospital should be primarily for the treatment

of the non-transportable—that is to say, for those who cannot be moved further without endangering their lives or seriously aggravating their condition. Such are:

1. Those suffering from or in danger of a recurrence of hemorrhage, requiring ligature or transfusion or both. No man should ever be evacuated to the rear from a field ambulance with a tourniquet on.

2. Those with chest or abdominal injuries.

3. All cases of shock.

4. Certain compound fractures, especially of the thigh, all of which should be here stopped, carefully examined as to shock and their splinting and only sent on when it seems safe to do so.

At these hospitals one cannot expect to get through without losing at least 30 per cent of the wounded. This brings down the mortality of the evacuation hospital and takes a tremendous load off their operating staff, as they have to spend so much more time on such cases. Besides, as he rightly says, the non-transportable are non-evacuable also and would have to be held at the evacuation hospital anyway. They are also popular with regimental surgeons, who, in the confusion and hurry of the front, are unable to handle these desperate cases and unwilling to expose them to a long trip.

. . . . . .

Now, gentlemen, we are ready to apply what we have seen; these things that I have cited are facts that we needed before we could really discuss what we are going to do with our own field hospitals. Take our field hospitals as they are. They are not equipped for this war, but they are being equipped. There are some who think that the field hospital should be a divisional unit and should be looked to to do emergency surgery at the front, and there are many very excellent men here and in the United States—natural leaders in the States in surgery—who say that we divisional people should not be entrusted with the surgical care of the wounded. True, this sentiment is not expressed as plainly as that, but it is there. But what are the facts? Are they right about it that we are not equipped—that we have not the experience as a class of men? They may be. Some of us, individually, may be very fine surgeons; but, in general, the general practitioner is not equipped to do the delicate work on these desperately wounded men. It is naturally right and proper that some experience be required of those who are to do this kind of work—that is to say, it is the business of an operating team, or more than one team, at these field hospitals; and it should not be resented by us that we should be required to show our fitness for this delicate surgical work. But let us answer them, as we all will, that we will learn their game; that we are going to fit ourselves to carry on at a field hospital; that we will learn how to do this work from their leaders,

through teams. That's the whole question and that is the idea of this school. Surgeons are none too plentiful as it is. I know of one division that organized five teams from their own personnel and had to lend three of them to evacuation hospitals in their rear. We are endeavoring to bring together the base people and the front people, that we may get good coöperation. All the men at the front were at first looked upon in all armies as men capable of handling only emergency surgery that anyone might do, and the men at the front strafed the men at the rear because they said they didn't know anything about the war. And in a way they were both right. We are trying to break that down by bringing these elements into contact, the men at the base and the men at the front, and when we do it we will have a medical corps that is ideal.

These ideas on the field hospital are personal, collected from what we have seen in the course of a year and a half in France. But I believe this is the solution of the problem. If I didn't believe it I wouldn't give it to a class of medical officers. We have four field hospitals. I believe two should be surgical hospitals, one a gas hospital, which, when not receiving gas cases will be receiving men who have become tired out, as a rest station, and the last should be a medical hospital, which will take in not only the current sick but which should have some control over the venereal labor camp, and the hospitals or wards for contagious and skin diseases. If you will look at it in the following way you will understand: Up to the present time, in the fifty-two weeks of the year, fifty weeks are spent in inactivity and two weeks in activity. We should bear in mind that our men should be made comfortable in at least those fifty weeks if in quiet sectors and periods of inactivity. Conditions approximating civil ones should prevail under these circumstances wherever possible. We should try to meet the conditions and endeavor to keep men at the front, make them comfortable and keep them from getting lost by being sent back to the rear. The field hospital should be so equipped and so supplied that it should be able to go with its division at a moment's notice, to take part in an advance or retreat, and, when it is stationary, to take care of the sick, wounded and gassed men to the best possible advantage, and with the proper men and the proper staff it will do it. They are ordinarily immobilized, but when movement comes they should be allowed to cut loose and go ahead. There is only one way to do that and that is to have the correct medical service organization. There should be under the corps surgeon an advance medical supply depot which should be a receptacle to take care of all stuff of the field hospital which has become immobilized, and which should store it and keep it against the day when it becomes again immobilized. Or, when such a thing is feasible, the corps field hospital might come up and take over the hospital which they have immobilized and work it as an evacuation

hospital, allowing the field hospital to go on. The field hospital thus loses none of the dignity of its position, but becomes more important than it ever was and is not confronted with the impossible task of caring for all wounded.

Now to get down to bare facts. Our tents are absolutely improper, inadequate for this war. The Bessonneau tent is so far ahead of our tent that there is no comparison; there is no question about it. The double-walled tent is a warm tent; the single-walled tent is a hot tent in summer, and a mighty cold one in cold weather. The Dixon is a wider tent than the Bessonneau; otherwise they are about the same. They are built on the cantilever bridge style, one portion supporting another. One could be used very well in time of activity as a triage and an office, and this is where they take the wounded. Why have a dinky little office somewhere else when office work is practically limited in battle to this tent—unless you become immobilized. Another should be used for the pre-operating tent where men may be washed up and prepared for operation, deshocked, and transfused if necessary. The other ten tents are wards. In addition to that we have certain other tents. I am going to give you the equipment for these surgical hospitals when they are immobilized and then tell you what things are to be left behind when the field hospital goes into action. Plus the above-mentioned tents you should have one large ward tent, old type, for stores; that's the way to use up the old tentage. Another similar ward tent should be provided for a dining room; you should not require the corps men to eat out in the open, and there should be a plain hospital tent for a kitchen and one for kitchen stores. The kitchen should be under cover; the kitchen stores should be separated from other hospital stores, of course. And you should have ten pyramidal tents for your men. It is perhaps true that they *will* hold 15 or 16 men, but, as a matter of fact, that tent will not hold more than 8 or 10 comfortably. You should have seven wall tents for your officers because you will have more officers in this new surgical hospital than our manual calls for. Our manual calls for 6 officers to a field hospital; one, the major, has a tent to himself. But to that number of officers you should add those of one or more operating teams. On your operating teams we will have one female anesthetist and one female assistant; we are probably not going to have male assistants to operators. These two girls will have to be put in a tent. Then there is the medical officer of a resuscitation team. These resuscitation teams are extremely important. They do nearly as much good as an operating team and they are fully as indispensable. There should be one radiologist and one bacteriologist with the mobile outfit. It is foolish to say you can't use a mobile bacteriological laboratory at the front—you can. The following dependencies are noted *only when the hospital is immobilized*: A carpenter shop; a

machine shop with a "smithy"; a tailor shop to keep your men neat and looking well; a cobbler shop to keep your men well shod; a barber shop; a canteen, and, separate from it, a recreation hut, which should be furnished by the Red Cross; a bath; a delousing plant; and an office, because when you settle down and are immobilized you want a separate office outside the triage, which is a very noisy place for a steady diet; a laboratory; a feces and garbage incinerator, with a bucket latrine and a pack store, where you take up your equipment and keep it. This may seem like a lot for a field hospital, but if you haven't a lot of these things your men are not going to be comfortable in the dreary days of inactivity, as comfortable as you can make them; and these things are furnished universally by the British, as I have seen them. They do it, and the French do it too, and we have got to do it. We are not doing it anywhere near enough, and we have got to do it.

Now *in inactivity*—I am talking about when we are not attacking or being attacked—such a place can be kept up as a regular place for the field hospital when the division has taken a certain position, a certain sector; and until that position is changed it should be kept right up, and the corps should keep it up. When the field hospital goes out it takes with it its combat equipment and the outfit replacing it takes the rest of it over and it becomes the property of the next man. A field hospital settles down in a little town, in cellars or perhaps a chateau where you can accommodate lots of these dependencies or the operating equipment and you won't have to use all your tents. Generally, however, you have to use your Bessonneau tent, your admission tent, and your preoperation tent, and as many ward tents as may be needed to house your patients after houses or barracks are occupied. During inactivity, the post medical supply should be requisitioned—I am saying this advisedly, and I am probably going to bring on a storm of disapproval by it. There are plenty of men who say that is theory; that this is war and you are not back in "posts." I am not thinking about "post" life at all; I am thinking about what I have seen in war myself. They have these things in the French and the British armies, and the men are more comfortable by reason thereof. You find them sleeping in iron bunks with sheets and pillow cases; and you will find there everything a well-regulated hospital should have, and there is no reason why you shouldn't, as long as things are quiet. The whole supply for a field hospital will have to be revised; it is being revised right now. We have a great many things we don't need and there are a great many things we will have to have. As it is now we have a field hospital per our Manual of the Medical Department that, if taken into the field with the name field hospital attached to it, we are not going to do for our soldiers the things we ought to do for them; we are not supplying to the soldier what he has the right to expect when he is in hospital. They are not hospitals; they are merely

temporary shelters, with dressing station equipment, and we have got to supply a very different sort of thing for the future. Where everything heretofore has been sacrificed to mobility we have got to make a distinction between those things which we will leave behind in a move until things are quiet, and our absolute needs to provide an emergency hospital of modern type in the field of battle.

Another thing. This is the hospital where the Red Cross should be allowed to help furnish. They can furnish a lot of things that we can get in no other way, and every one would make a soldier better off. Do you remember what Colonel Crile said about the predisposing causes of shock? Cold, lack of comfort, that little by little take away the soldier's percentage of safety. And you have the answer right there. These Red Cross people should be allowed to furnish wicker chairs, games, all kinds of medical comforts,including commissary stuff; they should be allowed to decorate wards, to paint, to whitewash, to provide tables, writing materials, magazines, books, tennis balls and rackets, footballs, baseballs, bats, physical-culture men, if you want them, for that period of inactivity. Now when the field hospital is ordered to the front in an advance,the corps medical supply depot or the army can take over all that property not possible to carry and hold it for the unit. In fact the best way is to have a corps or army field hospital move into and run it as a stationary hospital. It might be possible to simply put a guard over it. A triage tent, a pre-operating tent, and twelve Bessonneaus should go with the field hospital into combat. They should go on the same principle that you would transport a heavy gun, and if this augmented equipment is lost it should be viewed in the same light as the loss of big guns. You have to have the gun to kill boches, and you have to have your equipment to take care of wounded men so you can fix them up and get them promptly into shape to kill more boches. Your mobile surgical unit, with its equipment and, of course, your operating team goes, and your resuscitation team goes, and your personnel goes. Then you should carry on with you all those things that you know you are going to need in that battle, and somebody has got to sit down and say what should be carried forward and what should not go. For instance, you should carry gauze and cotton and Thomas splints up with you, but you needn't carry any atomizers up with you. Any of you nose and throat men know that while it might perhaps do some good it doesn't do enough good to warrant loading yourselves down with such things. Lots of medicines need not go.

We have got to have more of certain things; more and better instruments—no question about that part of it. We ought to have portable deshocking apparatus, and a number of other things we haven't today. That goes forward on the trucks that you have. You get to the place where you are going and you unload. You are going to use these trucks

perhaps for the transportation of wounded. You don't know how long you are going to be there. The other surgical hospital behind you eventually moves ahead of you when the advance takes place. When there is such an advance the one behind moves ahead and jumps over the one in front of it and establishes itself in front in the same relative position to the fighting troops as the first one had. Then it opens and takes the wounded coming to the rear off the hands of the first. The wounded in the first hospital being evacuated to the evacuation hospital, that hospital in the rear then moves forward to a point in front of the field hospital which preceded it, leap-frog fashion. This tandem work has been tried out in the 32d Division and has given good satisfaction in the second Battle of the Marne. It seems to be a very sensible proposition. In retreat the process is reversed. Now, when stationary warfare comes on again you can build about you with the aid of the corps surgeon the things you left behind when you were inactive.

In a war of movement the surgical hospital farthest to the front should conduct the whole triage with a seperate department therefor. If your corps surgeon or your division surgeon insists on triage at one place, this is the place to do it. The triage should never be done where you cannot apply the remedy to the cases that desperately need it. Otherwise it is an utter loss of time and a destruction of that man's limit of safety by exposing him to cold, to fear, and to chill. The cases that should always be detained this advance surgical hospital are chest cases, abdominal cases—chest cases will die if you send them back with open wounds—severe compound fractures, shock and hemorrhage. That is taken directly from M. Okinczyc's estimate of what this hospital ought to be used for. Here is one of the great arguments for this place: You never have assurance that you can get to the casualty clearing station, to the evacuation hospital, because as we have seen in this last push they are left far behind over crowded roads, with scanty transportation to get at them, and desperately wounded men at the front are utterly deprived of the proper sort of help. You have got to provide for that on the way back.

Now we come to the gas hospital. The gas hospital is rapidly taking form under the excellent administration of Colonel Gilchrist. He has an outfit, a portable degassing outfit. There are two of them to a division. It consists of a large 1,200-gallon tank of water, which is really a portable bath, and all the material necessary to do the bathing and degassing of these patients. Therefore the gas hospital should contain ten Bessonneau tents for the accommodation of your patients, 300 by crowding them in on litters—you are not taking beds with you this time; one large old-type ward tent for stores—got to have that; one for a dining room; one hospital tent for kitchen and one for kitchen stores; ten pyramidal tents for men, and six more tents for officers and nurses.

You may have to cut some of that tentage down, especially that for personnel, but you should hang on to your ward tents and receiving tent to do triage in, and the portable degassing outfit. Now when you get settled and things quiet down, that becomes a place where you can send men from time to time for rest, and as a rest station this field hospital should take on all the characteristics we have described for the others, with its cobbler shop, carpenter shop, etc. The number of men is the same, and the Red Cross here should be especially active to provide recreation games, theatricals, music, comforts, etc. In regard to gas, remember what happened in the 26th Division—that only 10 to 15 per cent of the people supposed to be gassed really were, and the rest were only exhausted, mentally and physically. You see the gas hospital is the natural place to have a rest station, and a rest station in the strict sense of the word.

Now we come to the medical hospital. They should have eleven Bessonneau tents—one for triage and the rest for wards; one for kitchen, one for stores, ten tents for the men and six for the officers. Same as the outfit for the gas hospital and the surgical hospital minus the degassing outfit and the surgical equipment, but it should include baths and be equipped to run skin and venereal wards. You can delouse these skin patients, but you want them separated from the others if you can. The medical hospital should have its division consulting physician, and the gas officer should have his headquarters here at the gas hospital. In that way you have within the division the head of the evacuation system offering real hospital conditions of a temporary emergency nature to men desperately needing it and who can get it only with great difficulty otherwise. I believe that is the situation as far as we can develop it in our army today in France. I don't believe all of these things are going to be carried out because I am sure somebody will develop much better ideas than I have, but I believe in general the plan should be followed because it seems to me to be built on facts in this war, and it seems to me to be something which the conditions imperatively demand.

That finishes the consideration of the field hospital as far as I am able to give it to you, but one thing should be made very plain: Whenever nearness to the line, good roads, and a quiet sector permit, practically all wounded should go direct to the evacuation hospital where the triage can be made. To stop a man on the way there is never an ideal; it should be only done in time of stress. Just as an evacuation hospital in a push cannot operate on slightly wounded as a rule, which they send to the stationary hospital in their rear, so the desperately wounded when the roads are clogged should be taken care of farther to the front, and here the triage must be done to prevent them from being carted to the wrong place or dumped in a confused heap on an overworked central

hospital, such as the evacuation hospital comes to be. In fact in a war of movement and severe operations from intrenched positions triage is necessary, but it must not be done as it has been done. It needs an experienced officer of the best type to facilitate and not hinder the prompt delivery of the patient to his final destination for definite treatment. The full 90 per cent of slightly wounded can be sent clear to general hospital 150 kilometers in the rear, suffer there, from twenty-four to thirty-six hours thereafter, a surgical removal of devitalized tissue and the foreign body and a closure by retarded suture from three to five days thereafter, and their wounds will heal by primary intention, but to relieve evacuation hospitals of these cases needs a good triage officer to make it a success.

REMEMBER THE OCTOBER MEETING AT ST. LOUIS, MISSOURI, FROM THE 13th to 15th OF THE MONTH

PROBLEMS IN THE CONTROL OF INFECTIOUS DISEASES AT REPLACEMENT DEPOTS

By Colonel O. G. BROWN
Medical Corps, United States Army

AT LARGE replacement depots, in time of war, the problems encountered in the control of contagious diseases were new and unusual. Owing to the unprecedented requirements, old systems of control served as little more than a basis upon which to build a new system which would meet the altered conditions. The population of the camps was constantly changing. Exposure to infectious diseases was general. Men had to be considered by thousands rather than by individuals. It was of paramount importance that medical and sanitary work be accomplished in such a manner as not to seriously interfere with the military machinery of the movement of troops.

Representatives of the Bureau of Laboratories and Infectious Diseases were always available to proceed to camps as their services were needed, to assist in the examination of cases of infectious disease and to advise in problems of isolation and quarantine.

The principal replacement camp of the American Expeditionary Forces was the First Replacement Depot, located at St. Aignan sur Cher. The function of this depot was to operate as a source of supply for the replacement of men lost in action or through other casualties throughout the A. E. F. Most of the troops at the First Replacement Depot came directly from the mobilization camps in the United States. A smaller number were patients discharged as cured from American military hospitals in France.

At the replacement depot the men were examined physically, fully equipped for field service, and, if time permitted, were given a brief period of military training before being sent to the front. At the height of military operations the rate of flow through the camp was about 100,000 a month. The stay of a soldier at the depot varied from a few days to several weeks.

The depot was divided into two parts, first, a classification or receiving center, and second, holding camps where the men were quartered until such time as they could be evacuated. Large, well-equipped hospitals were provided for the care of the sick.

Upon the arrival of the troops at the depot, there were, as was to have been expected, many cases of infectious disease among them. The conditions under which the troops had been mobilized and transported were such as to favor the spread of infections. The men had been

gathered from all sections of the country and concentrated in large mobilization camps in the United States. All were young, and consequently peculiarly susceptible to infections. From the concentration camps they were transferred to crowded ships. Large numbers had to sleep together in congested quarters below deck. The ventilation was necessarily poor. Portholes could not be opened, as the ships had to be kept darkened to avoid submarine attack. Although all precautions had been taken to prevent the transportation of infected men it was inevitable that some of them should develop infection on board ship. Under these conditions the kindlings were laid, ready for the match to start the conflagration. One case of measles was enough to start an epidemic on shipboard. Isolation was a matter of extreme difficulty and, in the presence of a large number of cases, was frequently impossible.

From the ships the men were rapidly entrained and further transported in box cars. At the base ports infected men and their contacts had been removed, as far as it was possible to do so, but there necessarily remained numerous foci of infection among the men entrained.

It is not surprising that, upon the arrival of troops at the First Replacement Depot, every increment brought with it cases of measles, mumps, cerebrospinal meningitis and almost every other disease known to man.

At St. Aignan the control of infectious diseases divided itself into two parts: first, the segregation and weeding out of the men already infected and, second, the isolation and treatment of the contacts, to prevent further spread of infection.

Medical officers met all trains. New arrivals were lined up and given a rapid medical examination before being sent to their quarters at the classification camp. This examination was necessarily hurried. Its object was to pick out the men manifestly sick, who needed hospitalization. The following day the men were all given baths and were required to pass naked before a board of medical examiners, at which time a more critical and minute physical examination was given. Men in whom defects were discovered, and who required careful examination, were immediately sent into a separate room, where they were carefully inspected by a board of specialists. On this board there was a neurologist, urologist, orthopedist, and a specialist in internal medicine. The men who were found physically fit were permitted to proceed to their quarters. The sick were sent to hospital. Contacts were investigated.

It soon became apparent that wholesale quarantine, for prolonged periods, could not be established for the large groups of men. The exposure to infection had been so general, that to establish wholesale quarantine would have necessitated the keeping of tens of thousands of men at St. Aignan for weeks at a time, and would have held up military

operations, as these men were urgently needed at the front. Moreover, efficient quarantine was difficult, as the men were billeted throughout large areas, and frequently lived in houses occupied by civilian families. It was impossible to keep quarantined men so placed from coming into contact with outsiders. Frequently less disease would be developed in the quarantined groups than among those outside quarantine.

To meet these conditions a system of compromise had to be adopted. Contacts were divided into two classes: immediate contacts and remote contacts. Immediate contacts included the men who slept close by the infected cases, sat beside them at table, or were their close friends or "buddies." Remote contacts included the men who were in the same company or had traveled on the same train with infected men. In nearly all cases only the immediate contacts were isolated. Remote contacts were disregarded, except in the case of the virulent infections.

As extensive quarantine within the classification camp had proved impracticable, it was discontinued. All cases of infectious disease and their immediate contacts were sent to the hospital for observation and treatment, immediately upon their detection. An exception to this rule was made in the case of influenza. This epidemic was so widespread and entailed so great a mortality that the remote contacts as well as immediate contacts were segregated and carefully watched. Contacts were placed in detached groups of buildings at the classification camp, where they were examined twice daily by medical officers, temperatures being taken at each examination.

The control of diphtheria, measles, mumps, meningitis, typhoid fever and influenza will be described in detail, as they demanded special attention on account of their frequency and virulence.

Diphtheria.—Cases of suspected diphtheria and their immediate contacts were sent to the hospital immediately upon their detection. Those showing positive cultures were kept under observation until three sucsive cultures, taken a week apart, were reported as negative. Contacts having negative cultures were not detained.

Shick tests were made of entire organizations in which two or more cases had occurred at about the same time. Men showing positive reactions were held under close observation for the period of incubation. Their temperatures were taken and throats examined daily.

Measles.—Special attention was paid to measles in view of the possible complication of pneumonia. Measles cases and their immediate contacts were sent to hospital, the contacts being kept under observation there for the period of incubation.

Mumps.—Patients having mumps were sent to hospital and were kept there for a period of not less than twenty-one days. Contacts were not detained, as the disease is not dangerous to life, and the cases were no numerous and the incubation period so long that an undue amount of hospitalization would have been required for their isolation.

Meningitis.—On account of its high mortality very stringent measures were at first employed in the quarantine against this disease. Entire companies and battalions were isolated under guard upon the appearance of a single case of meningitis within the command. No one was allowed to enter or leave the quarantined area without special permission from the division commander. Men in quarantine were required to spray the nose and throat three times daily with Dakin solution. This rigid quarantine was found difficult to maintain. The results were not satisfactory. Sporadic cases of meningitis were of frequent occurrence. Wholesale quarantine was soon discontinued. Instead, immediate contacts were promptly evacuated to the hospital, where cultures were taken from their throats, in order to determine whether or not they required detention. Positive cases were kept under close surveillance in hospital wards.

Typhoid Fever.—At St. Aignan the outbreak of typhoid fever was limited to one replacement organization. In that organization about forty cases were detected within a few days of each other. They had all come from the same mobilization camp in the United States. The infection was particularly severe. Eight or ten died. Perforations occurred in three cases, all of which were operated upon and made subsequent recovery. Typhoid cases and their contacts were isolated in hospital. The stools and urine of contacts and all men working about kitchens and mess halls were examined in an effort to locate carriers. None were found. Cases were kept in hospital after their recovery until four examinations of stools and urine, made a week apart, were reported negative. The epidemic was studied by the Bureau of Laboratories.

It was found that many cases of typhoid had occurred in the camp in the United States from which the affected men at St. Aignan had come. It was shown that the men had been exposed to a gross infection and it was believed that the epidemic was due rather to the overwhelming infection than to failures in the administration of typhoid vaccine.

An epidemic of typhoid fever at another camp in France came under the observation of the writer. At that camp, six or eight cases of typhoid or paratyphoid a day were reported at the height of the epidemic. The command had just been brought back from the front into a rest area. Both at the front and in the rest area the drinking water was open to suspicion. In the rest area typhoid fever was known to be prevalent among the civilian population. Some of the cases had developed infection at the front and some in the rest area.

Some disagreement existed as to whether the disease had been disseminated by carriers or through the drinking water. Both were regarded as possible sources and protective measures were established on that basis.

Every man in the organization was examined daily by a physician.

All complaining of slight indisposition were carefully watched. Men having fevers of undetermined origin were isolated in hospitals. Stools and urine of contacts and suspicious cases were examined. The entire command was reinoculated against typhoid fever. The stools and urine of men working about kitchens were examined. No changes of kitchen personnel were permitted during the epidemic.

An extensive campaign for the protection of the drinking water was inaugurated. Numerous Lyster bags containing chlorinated water were placed conveniently to kitchens, mess halls and billets. The drinking of unchlorinated water was punished by court-martial proceedings. Guards patrolled the streams and were posted at hydrants and water taps to prevent the unauthorized use of water from those sources. Placards were posted throughout the town, and expecially at sources of water supply, prohibiting the drinking of unchlorinated water. As soon as this water discipline had been thoroughly organized a sudden drop occurred in the number of cases of typhoid fever. After two weeks of its enforcement no new cases occurred.

Influenza.—The epidemic of the so-called "Spanish flu" reached St. Aignan through replacements from the United States. The sickness and death from this cause, for a time, equalled the rate from typhoid fever in armies prior to the days of protective inoculation. The deaths, for a time, numbered twenty or more a day.

Unusual precautions were taken in handling these cases. Contacts, immediate and remote, were placed in a separate part of the camp and isolated there for ten days. Each man in quarantine was examined twice daily by a physician. The slightly sick were immediately evacuated to the hospital. A floor space of forty square feet per man was insisted upon. When space was not available in barracks, men were placed in pup tents. To prevent men coughing in each other's faces at night, the men sleeping beside each other were required to lie in opposite directions, so that the head of each man was opposite the feet of his neighbor on either side. Officers of the day were required to inspect sleeping quarters at night to enforce these instructions and to see that maximum ventilation was being maintained by keeping doors and windows open. In companies where the "flu" was especially prevalent, all men were required to wear masks. It is believed that the most useful factor in the control of this epidemic was the prompt removal of infected men upon their showing the first symptoms of the disease.

Of the influenza cases, nearly one-third developed pneumonia. The mortality of the pneumonia cases ranged from 20 to 45 per cent, at different stages of the epidemic.

In the control of infectious diseases at the First Replacement Depot the ideal had to be subordinated to the practical. Time-honored principles and procedures suffered violence in the process, but events showed

that St. Aignan fulfilled its functions as a strainer without unduly retarding the stream of replacements which passed through it. The number of acute infectious diseases at the front was always negligible. The number of cases at the mobilization camps and base ports, from which replacements were drawn, was uniformly high. There were never more than two hundred men in quarantine or two thousand in hospital at St. Aignan at a time, although the troops passing through the depot sometimes numbered four thousand a day.

REMEMBER THE ANNUAL MEETING
IN ST. LOUIS, MISSOURI, FROM
OCTOBER 13th to 15th.

GAS WARFARE—ITS AFTERMATH

By Major JOSEPH CATTON[1]
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IMMEDIATELY following the introduction of gas warfare in 1915, clinical and experimental research was instituted looking toward the nature of the gases, their lesions, and the indicated therapy.

The subject matter of this communication is derived from available medical journals; the memoranda, communications and atlases published under the direction of the American and the Allied governments; certain captured German documents; a study of some 1,500 gas cases, during October, November and December, 1918, in Base Hospital 64 A. E. F., and studies of gassed cases at a later date in other hospitals in France.

Various gases have been used as weapons. The list includes hydrocyanic acid and sulphur dioxide. Benzyl bromide was used as a lacrymator. Although probably not used intentionally for that purpose, nitric peroxide, from high explosives, has caused some casualties; likewise carbon monoxide from imperfect combustion, close quarters, burning buildings and mining operations, have caused damage. The gases most used have been: (*a*) The suffocant gasses, including phosgene ($COCl_2$), diphosgene, chlorine and chloropicrin; (*b*) the vesicant gas, variously called mustard gas, yperite or Yellow Cross, and whose formula is di-chlor-ethyl-sulphide $(C_2H_4Cl)_2S$. Latterly the two mainly used gases were phosgene and mustard.

Gasses were first sent over in clouds from cylinders, but very soon they were distributed by gas shells and gas bombs. The suffocants produce their lesions through being inhaled. Mustard gas may affect by its inhalation in the finely divided state as a vapor, or by contact with it, in the oily state. The oil may cling to ammunition and clothing. Hospital attendants, as far back as in a base hospital, have received burns from using salvaged clothing of gassed patients five days after exposure. Food, or water from shell holes or wells, may be gassed, and even after several weeks, when taken into the gastrointestinal tract, may cause symptoms.

This communication concerns itself especially with the conditions which may be looked for in the thousands of soldiers returning to civilian life, who will include in their medical histories, "Yes, I was gassed." It is necessary, however, to consider the initial pathology and symptomo-

[1] Successively, Chief of Medical Service of Camp Fremont Base Hospital, Base Hospital 64, U. S. Convalescent Hospital 2, and Base Hospital 99, A. E. F.

tology of gas cases in order more clearly to understand the possible aftermath.

PATHOLOGY

Suffocant Gases.—These gases are pulmonary irritants. Phosgene, ($COCl_2$), was probably the most commonly used gas of this type. In three to twelve hours after exposure, it causes an outpouring, sometimes of an enormous quantity, of fluid into the alveoli and bronchioles, and later into the lung tissue. Coincidently, there develops an acute inflammatory reaction throughout the entire lung. The capillaries are congested and are compressed by the edema; there is a great tendency towards thrombosis in the smaller vessels. The lymphatic spaces are gorged and lymph drainage may not keep up with lymph production. As these processes become further advanced and violent fits of coughing set in, there is some destruction of the alveolar epithelium and bursting of air vesicles, a disruptive emphysema. At the same time, the blood is becoming concentrated and viscosity increases; an initial transitory oligemia is followed by a polycythemia and an increase in the percentage of hemoglobin. The edema; capillary congestion, compression and thromboses; and the slowed flow of thickened blood through the lung, all contribute to a state of oxygen deficiency. With this oxygen deficiency there come temporary and probably, at times, permanent changes in various systems, especially the central nervous system. While the actual oxygen content of the blood may not always be diminished there is, in these cases, evidence of local or more general deficiency in oxidative processes in various organs and tissues. The pathology in the lungs leads sooner or later to more or less failure of the right heart, and the latter in turn to greater oxygen deficiency. The failing circulation may be accompanied by acidosis.

The only other pathology attributed to phosgene has been that seen in the blood vessels. Thromboses have been found in the smaller vessels of the lungs, kidneys, stomach mucosa, the brain and the extremities. Gangrene may supervene in the extremities. Larger thromboses have been found in the heart. There have been petechial hemorrhages on the surfaces of the lungs and heart, on the inner side of the cardiac stomach, and in the brain; there have been larger hemorrhages into the brain. In addition to the thromboses and petechial hemorrhages, the stomach has shown larger hemorrhages filling the organ-superficial ulcerations and in some cases marked extension of these ulcerations.

The evidence to date would indicate that phosgene, as such, is not absorbed and that the lung is probably its sole seat of action. The mechanism of thrombus formation in these cases is not clear. The circulatory failure and thickened blood may be factors in any of the thrombi; the slowed blood stream in the lungs may be a factor in the thrombi

there. Bronchitis or lobar or broncho-pneumonia may supervene; the pneumonias, however, are not common. The effects of gas differ from those of infection of the respiratory tract; gas does more damage to the lung parenchyma, affects the lung more universally, and causes *per se* no systemic poisoning.

Vesicant Gases.—Mustard gas acts in an entirely different manner. Some hours pass before pathology is apparent. In contrast to phosgene poisoning in which it appears, the main seat of election is the respiratory tract; mustard gas affects almost every tissue with which it comes in contact. The common sites of pathology are the conjunctivæ, the skin, the upper respiratory tract, and the pharynx.

The eyes may show slight degeneration of the corneal and conjunctival epithelium and simple conjunctivitis, or more or less complete necrosis of the corneal vertex extending through its entire depth. In more severe cases there may be iritis or irido-cyclitis, necrosis of the conjunctival epithelium or panopthalmitis.

The skin affected is over the exposed portions such as the hands, the skin around the borders of the respirator, and the sweaty places—the axillæ, flexure of the elbows, the groins and perineum. The lesions are erythema, blisters and sometimes deep burns. Usually pigmentation and desquamation follow, and cicatrices if the lesions have been deep.

The pharynx is usually only injected, but in the severe cases it may ulcerate.

The lesions of the respiratory tract are very different from those of phosgene. Mustard gas attacks primarily the larger tubes, while phosgene attacks the entire lining, including that of the alveoli. Rather than calling out a great edema, mustard gas actually burns the respiratory lining, and there occur necrosis, ulceration and sloughing. Secondary infection of these lesions always supervenes. It is not the rule in this type of poisoning to see the marked interference with aeration or the consequent changes in the nervous system and other systems. There is, however, a limited number of cases with sufficient pulmonary lesions to bring about these conditions. There is evidence of increase in blood urea, of diminution in the total amount of urine and of chloride and urea excretion, and of increase in the specific gravity and acidity of the urine.

PATHOLOGICAL PHYSIOLOGY

Phosgene.—So much for anatomical pathology. In addition to the structural changes found in phosgene cases, there are marked changes from normal, in various physiological processes. There is much evidence of initial disturbance in the bulbar centers associated with the automatic nervous sytem, especially the vasomotor, respiratory, cardio-augmentor and cardio-inhibitory centers. The lesions of these centers

appear not to be due to the direct action of absorbed gas, nor to impulses coming up the vagus, but rather to deficient oxidative processes and in some measure possibly to absorption of toxic products from the lungs. As a result of these disturbances there are seen shallow breathing, lack of increase in depth of respirations to compensate for decrease in rate in recumbent position, a tendency toward disturbed tone in the bronchial musculature, rapid heart, vasomotor disturbances, etc. There is evidence that the nervous changes and the consequent interference with oxidative processes may be more or less permanent. For example, it has been found that gassed cases, months after exposure, may still have many of the early symptoms and signs; that they cannot tolerate a lowering of atmospheric pressure below an equivalent of an altitude of 5,000 feet, although such a change does not bother a normal individual. In mountain sickness, too, there is a disturbance in oxidative processes, due in this case to lowered oxygen pressure. Here, however, the changes of a compensatory nature usually take place quickly; in the acute and overwhelming attack made by gas, attempts at adaptation may fail and there occur the changes described.

EARLY CLINICAL PICTURES IN GAS CASES

Phosgene.—It has been indicated that the pathology of the lung irritants does not develop in marked degree, for some minutes at the very least, and that usually there is a delay of from three to twelve hours. Accordingly, aside from an irritation and watering of the eyes, a slight anorexia, and an unpleasant taste for tobacco smoke immediately following the inhalation of the gas, there may be no symptoms until there have come the edema, capillary obstruction, secondary oxygen deficiency and cardiac embarrassment. Then there are seen the catching breath, choking sensations, tight chest, and inability to take a deep breath. Later comes cough with more or less expectoration, and maybe vomiting. Whether the vomiting is central or due to impulses over the vagus or to the gastric pathology already mentioned is not clear. At this time examination shows all the signs of lung edema and congestion, and sometimes there are mental findings such as disorientation. If the case is severe, to these symptoms and signs are added those representing the more pronounced pathology, and there are two great classes of these cases.

(*a*) *The Blue Case.*—If the circulatory apparatus is functioning well, there is seen a patient, cyanotic, with turgid congested face and neck and distended superficial veins. Dyspnea is marked, but the breathing fairly deep. The pulse is of good volume, well sustained, and probably not over a hundred a minute in rate.

(*b*) *The Gray Case.*—If oxygen deficiency is sufficiently great, and in addition the right heart has begun to fail, there may be seen a patient,

pale, pudgy, gray, with leaden-colored mucosae. The breathing is rapid and shallow, the pulse of poor volume, not well sustained, and the rate high, even to 140 or more. The gray stage may supervene on the initial shock, or follow, more gradually, the blue stage.

Lesions of the nervous system were mentioned. Some cases show mild symptoms and signs referable to the central nervous and the autonomic systems. There may be disorientation; Kernig's sign, muscular weakness, nystagmus, Moebius' sign or unequal pupils, scattered sensory changes, absent abdominal reflexes or retention of urine. Whether or no some of these phenomena may not be independent of the gassing is not clear; they were more common after chloropicrin than phosgene. A case of chlorine poisoning from the gas house at Camp Fremont showed, for a period of an hour, increased knee and ankle jerks and clonus in both these regions and the Babinski and Oppenheim signs bilaterally; other nerve findings were normal. The organs of taste and smell are commonly disturbed.

There may be seen signs of thrombosis in the vessels of the extremities, even including gangrene.

Death may come in the initial stages from the flooding of the lung with edema and other changes described. Death is not common after the first few days. Some cases show a mild delirium or unconsciousness before death.

Some cases have shown a slowed pulse after gassing. The same sign has been found, at times, experimentally; it is not, however, the rule. At any stage of the poisoning the slightest exertion may develop symptoms of great severity in a patient supposedly only slightly gassed or may light up symptoms in a case well on the way to recovery.

The question naturally presents itself as to whether or no there is a similarity between the picture of lung edema in gas cases and that seen at times in nephritis, cardiac decompensation and other conditions. The edema of gas cases is much more severe, and it is accompanied by an acute inflammation, the result of the action of a lung irritant. However, the picture of hyperacute lung edema of nephritis and gas edema may be very similar. Dieulafoy's description of the nephritic variety might well be substituted for that given above of the early stages of phosgene poisoning. The sudden edema, pallor, cyanosis, dyspnea and pulse changes are identical; the lung signs are very similar; bleeding or oxygen relieve equally well the cyanotic cases of either. While, however, morphine and atropin may have found a place with some men in the treatment of the lung edema of nephritis, neither drug is indicated, and either may be harmful in gas cases.

Mustard.—The pathology of mustard gas was shown to develop even more slowly than that of phosgene, and so for a considerable period a soldier may be unaware that he has been gassed. Three to twenty-four hours elapse before symptoms appear.

The inflammatory reaction in the conjunctivae may cause smarting lacrymation and photophobia, and headaches, either over the eyes or more generalized. In severe cases the eyes may be closed for one to three days.

The pharyngeal lesions lead to distress in swallowing. There may appear early vomiting and severe epigastric pain, both of which tend to persist. Diarrhea may be a feature. The central, peripheral or reflex nature of these symptoms is not determined,

After about twelve hours the affected areas of skin show the erythema and then run the course outlined under pathology. Even after weeks, old, burned areas may show irritation and erythema after bathing in hot water. Blisters have developed some time after admittance to the base hospital.

The pathology in the upper respiratory tract leads early to hoarseness, harsh cough and retrosternal pain. In between twenty-four and forty-eight hours come the respiratory symptoms due to the secondary infection. The latter condition should be contrasted with the early appearance of distressing symptoms in phosgene cases due to edema. Any or all of the symptoms of mustard gas poisoning may grow quite severe, but the pathology that may eventuate in fatality is not usually that due to the direct effects of the gas, but to the secondary infection which has led to purulent and severe bronchitis or to pneumonia;[2] and death if it occurs in this type of case is usually an event of the first or second week.

LATER SYMPTOMS

In the non-fatal cases, in the days and weeks that follow, the symptomotology is most varied.

Phosgene.—These cases show symptoms traceable to bronchitis, or to persisting disturbance in the reflexes controlling respiration and heart and vasomotors. Dyspnea, chest pains usually precordial, cough, dizziness, tachycardia and vomiting are the main complaints. Fatigue is a marked symptom in about a third of the cases. In spite of the persistance of cough and chest symptoms, expectoration, later than the first few days, is not usual. Small râles may be heard in about one third of the cases.

Mustard.—These casualties may show a continuation of the conjunctivitis with photophobia, injection and discharge, and edema of the eyelids, and some of the later effects of the skin burns such as pigmentation, desquamation and rarely cicatrices. As in the case of phosgene, respiratory symptoms may continue. Although mustard gas has

[2] In the Base Hospital 64 series, about 2 per cent of the cases (the cases were received 12 to 72 hours after gassing) developed lobar or broncho-pneumonia. Data are not available as to the percentage in phosgene and mustard cases respectively. Influenza at the same hospital was twice as frequent in gassed as in non-gassed cases.

not affected the lungs so uniformly and generally, the lesions present have been destructive and the seat of secondary infection, so the cough is about twice as frequent as in phosgene. The pathology being in the larger tubes, there may be found a persisting laryngitis, aphonia functional or organic; and, on auscultation, large râles in contrast to the small ones of phosgene. The abdominal pain and vomiting and sometimes diarrhea may persist. Painful and frequent urination may be present, possibly the result of the occasional high urinary acidity and concentration. Fatigue is one of the less frequent symptoms.

RESIDUAL SYMPTOMS

When seen several weeks or months after gassing, the patients may still present symptom complexes referable to the initial pathology.

Mustard.—These cases, excepting in rare instances, show no symptoms referable to an early oxygen want and coincident damage to bulbar nervous structures. There may be a chronic bronchitis. Vomiting is at times persistent. Functional aphonia is not uncommon. Blepharospasm and photophobia may be features for some time.

Phosgene.—These cases are the more intractable. In gassed cases who have died from other causes sometime later, there have been found no evidences of persistent thickening of the alveolar walls or other persisting pulmonary lesions as has been suggested by certain observers. A subacute or chronic bronchitis may be a feature for many weeks. The question as to liability to pulmonary tuberculosis needs investigation. Persistent vomiting is very infrequently a symptom.

The most bothersome complaints and those that seem still to persist in patients seen at long periods after gassing are the following: dyspnea and tachycardia at rest and increased on the slightest exertion, precordial pains, excessive sweating, slight pallor or cyanosis of the extremities, dizziness, fatigue, unpleasant dreams and unrefreshing sleep. On examination there may be found evidences of vasomotor upset, certain of the eye signs found in hyperthyroidism, at times an enlarged thyroid, perhaps a slightly enlarged heart, a rapid pulse, or increased knee jerks. The patient may not be able to limit the number of respirations per minute to less than ten. The heart rate may not return to normal within two minutes after the increase incident to hopping 100 times on the left foot or similar exercise test; neither may the blood pressure return to normal after the same tests. These findings will be recognized as those that have been grouped together and variously termed Irritable Heart of Soldiers, Distorted Heart Action, Neurocirculatory Asthenia, and Effort Syndrome. And with this group of symptoms civilian physicians will have to deal for some time in gas cases.

Some cases show exaggeration of one or more symptoms of the group; for example, the findings may tend to fit a hyperthyroid picture; others

show the symptoms mentioned plus those of psychasthenia or neurasthenia.

To treat any of these complexes intelligently, one must know something of the pathology, etiological at the time. There is no evidence of true cardiac pathology excepting as a complication. Acute infections—for example, influenza—may have been a factor at first, but they have long since been removed, and one must look for the pathology present when the patient presents himself. On account of the tremor, nervousness, sweating, tachycardia and other symptoms and signs of thyroid hypersecretion, the latter condition has been thought by some to be the basis of the trouble; thyroid enlargement and exophthalmus have occurred, but they are not common. Some have blamed an irritable sympathetic for the whole picture; it should be noted, however, that there may be signs of voluntary nerve irritability as well. The so-called effort-syndrome cases resulting from gas are very similar to those seen in the United States and elsewhere and due to various causes.

What, then, is the pathological basis of these symptoms? The lesions that might remain in the lungs are not sufficient. Hemorrhages and thrombi found in the brain were certainly the basis of functional change and may possibly have caused organic change in nervous structures. There is experimental evidence of an initial depression of the bulbar autonomic centers of cardiac, respiratory and vasomotor control, and much clinical evidence that disturbance in these centers is lasting.

The symptoms in post-gassed cases and those seen in persons suffering from high altitudes (in balloons, airships or mountains) are similar. The disturbances in high altitudes are due to oxygen hunger. There is disturbance in oxidation in the early stages of gas poisoning, and the lesions of the centers controlling heart, lungs and vaso-motors may be expressed—especially when there is a demand for increase in oxidation—in an inability to absorb and distribute oxygen efficiently. The status resulting from flying or residence in high altitudes and the post-gas status have, in common: polycythemia, relative lymphocytosis, relative polynuclear leukopenia, increase in hemaglobin percentage; and increased respiratory and cardiac rates. Flying and gassing each may cause increase in blood concentration and sleepiness. Mountain sickness, in addition to a like list of phenomena, shares with the gas-status, fatigue, anorexia and nausea, palpitation and dyspnea, increased especially on exertion, disturbed sleep, and slight cyanosis of the extremities. Each condition interferes with holding the breath for as long a period as in the normal. Both are relieved by oxygen or rest. Aviators who have not compensated for the lack of oxygen, and the gassed, show similar disturbances in the cardio-respiratory reflexes.

When one considers the definite things—namely: (*a*) Initial oxygen want, and (*b*) continued disturbance in the cardiac, respiratory and vasomotor reflexes, which are essential to the proper functioning of the oxidative machine—it is not surprising to find the symptom pictures discussed, nor to find that certain compensatory reactions have been initiated in all the body systems. The most apparent are those already mentioned in the blood and in the nervous, circulatory and respiratory system. Now one and now another of these systems shows signs of excessive "whipping up," or, under too great or prolonged a strain, of breaking down, and so there is presented this or that group of symptoms. Congenital or acquired inferiority in a given organ or system may determine the picture presented; for example, some show the thyroid reaction, or the gassed soldier who is of the proper soil and who has been subjected to prolonged emotional stress may show psychoneurotic symptoms as well.

The aftermath of gas cases is varied. It is the expression of pathological physiology which may be more marked in one or another organ or system. It seems to be dependent, primarily, on interference with the proper functioning of certain reflexes concerned in efficient oxidation in the body. Treatment must aim to remove all etiology tending to interfere with oxidative processes (this includes correction through exercises, to an extent, of the disturbed cardiac and respiratory reflexes) and toward correcting the excess of manifestation through special organs or systems; for example, the thyroid.

SUMMARY

The following conditions may be suggested as the more likely to present themselves in soldiers some time after gassing:[3]

1. The syndrome variously called irritable heart of soldiers, disordered heart action, neuro-circulatory aesthenia or effort syndrome. In gas cases this group of symptoms seems to be due to disturbance in the cardiac, respiratory and vasomotor reflexes which, in addition to their other functions, are essential to oxidative processes. These patients may have more distress in those conditions presenting disturbance in oxidation including, anemias, cardiac and respiratory disease, and carbon monoxide poisoning. Coal tar drugs should be used with greater caution in these patients (P).

2. *Respiratory System:*

(*a*) Larynx; laryngitis; aphonia, functional (M).

(*b*) Bronchi; bronchitis, chronic (M) (P).

(*c*) Alveoli; localized emphysema and (P) disruptive emphysema. (The significance of these lesions is not clear.)

[3](P)—Phosgene. (M)—Mustard.

3. *Mental and Nervous System:*

(*a*) Psychoneuroses; psychasthenia (P); neurasthenia (P).

(*b*) Functional disturbances: aphonia (M), blephorospasm (M), photophobia (M).

(*c*) Autonomic disturbance especially of cardiac, respiratory and vaso-motor reflexes (P).

4. Pigmentation from burns (M). Cicatrices if burns have been deep (M).

The relation of gassing to pulmonary tuberculosis requires investigation. Gastrointestinal complaints have been intractable in some cases. The gastric lesions in phosgene cases have been described. There is much evidence as to the possibility of swallowing mustard gas, but the lesions are not as yet well known. The possibility of lesions in various viscera, as a result of extensive mustard burns, should be studied when one considers that nephritis, duodenal ulcer and hemaglobinurea have been considered to have resulted from burns due to other causes.

BLOOD TRANSFUSION AS A THERAPEUTIC AID IN SUBACUTE SEPSIS ASSOCIATED WITH WAR INJURIES

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Introduction.—This communication is intended to draw attention to the necessity for the more frequent and extensive use of small and repeated blood transfusions in our military base hospitals. It is only necessary to go through a series of wards containing surgical cases to realize how beneficial such transfusions would be for these pale, septic-looking and emaciated patients, who are making a difficult uphill struggle to save their limbs or even their lives. The great aid which is so badly needed in the form of a rich supply of red blood cells and blood protein is frequently withheld from these patients, partly by a lack of appreciation of the value of blood transfusion in such cases and partly by an absence of centralized special responsibility for carrying out these transfusions. During the rush period of actual war activities, also, an excessive amount of work for the individual officer and the insufficient surgical help, which existed at times, prevented the systematic and repeated transfusions of blood that were often indicated in suitable cases.

The officers performing blood transfusions also varied in the different base hospitals. Sometimes laboratory officers were called upon to do them, at other times a junior ward surgeon with little or no experience in such work, and, again, the Chief of the Surgical Service, would undertake to do the transfusion himself. The results of such various efforts and the absence of centralized interest in this particular phase of surgery can be seen in the relatively few transfusions that were and are being carried out. As these cases often requiring repeated blood transfusions are present now in most of the base hospitals and will continue to be present for some time, it is none too late to again call attention to the indications which are very definite in many of the cases. These indications can be summarized as follows:

Indications for Blood Transfusion:

1. Extensive suppurating wounds associated with a subacute form of sepsis.
2. Compound infected fractures associated with a subacute form of sepsis.
3. Various grades of anemia associated with a subacute form of sepsis.
4. Various grades of emaciation and partial marasmus.
5. Before and after severe operations as an emergency measure.

While in the forms of acute infections associated with a septicemia, blood transfusion has not shown any extraordinary results, in these more subacute forms with a prolonged and extensive suppuration the effects would be excellent. The freshly injected blood, introduced from time to time, acts in a most beneficial manner in increasing the resisting power, physical, chemical and immunological, of the patients. Every physician is acquainted with just such cases, in which transfusion of blood has saved lives. But in the saving of limbs, also, a fresh supply of nutritious blood is bound to become an important factor. In these cases the injected blood serves not only to replace the diminished number of red blood cells and the low hemoglobin content, but, as is well known, the injected plasma brings with it an abundance of nutritive and bactericidal properties.

For the anemias the transfusion of blood is certainly indicated. It supplies a fresh amount of blood and also stimulates the patient's blood-forming organs to continue producing an increased number of red blood cells. Yet we see many a patient in our base hospitals being allowed to carry on his struggle for recovery without the aid of blood transfusion.

Again, for the cases showing extensive grades of emaciation from various causes such transfusions are definitely indicated. These patients are not only emaciated, but their tissues are more or less devitalized. Such conditions are, of course, generally associated with prolonged sepsis, an inability of the body to properly utilize the ingested nourishment, and with various grades of anemia. They often develop bed sores from pressure upon their bony prominences. These patients have been, as a rule, lying around in the wards for some time, have gone through many a hard siege with their wounds, and do not seem to have sufficient recuperative power to enable them to convalesce properly. Repeated small blood transfusions, by acting as a new stimulant and an important nutritive element, will be certainly beneficial to their undernourished and devitalized tissues.

The cases requiring blood transfusion as an emergency surgical measure are self-evident. Yet lives are sacrificed by a failure to transfuse patients either before or, more often, after an extensive shock producing operation. In such cases the injection of blood is a pure life saving procedure and preparation for it by previouly knowing the blood group of the patient and having on hand a suitable donor, will often mean the difference between saving and losing the patient.

Donors of Blood.—Objections have sometimes been raised that donors are not easily obtainable. Anyone who has had experience with blood transfusions knows that donors can be secured if any consistent effort is made to get them. With the great desire on the part of many civilians to show their patriotic feelings in some direct way that would be

beneficial to the soldiers and with the generous spirit of our healthy soldiers, there should be no difficulty in having a classified list of tested donors who could be reached whenever needed. It is necessary, however, that each donor should be, if he so desires, properly remunerated for the blood which he gives. Relatives, also, of the wounded soldiers are in the States almost constantly available. It is not, therefore, a question of a lack of donors, but simply that of a little foresight and exertion on the part of those responsible for the blood transfusions.

The testing of donors and patients for blood grouping can be readily and conveniently accomplished by the method of Moss, using for the test a serum of Group II and one of Group III. These test-sera are kept in sealed glass capillaries, so as to have them in convenient form for immediate use. A drop of each of the two sera is placed on a clean glass slide and a drop of blood from the finger of donor or patient is added to each drop of serum. When no agglutination of the red blood cells takes place the individual belongs to Group I. When agglutination with serum of Group III occurs, and none with serum of Group II, he belongs to Group II; agglutination with serum of Group II, and none with serum of Group III, indicates that he belongs to Group III; when agglutination occurs with both sera it indicates that the individual being tested belongs to Group IV.

Special Operators in Charge of Blood Transfusions.—The great importance of the subject calls for the assignment of the work connected with blood transfusions to specially qualified officers. It would be very desirable that such an officer, fully conversant with the technical details and indications for transfusion, should be available in every base hospital and base hospital center. He could be called into consultation on suitable medical and surgical cases, in whom a transfusion is indicated. He even could in a general way know most of the very ill cases throughout the wards and help the surgeons in the selection of those suitable for transfusion.

This officer would also look to the constant availability of donors, and he himself or an assistant test the donors and patients for blood grouping. These tests should also be extended to the personnel of the hospital, who might at any time become available as donors. Wassermann tests should, of course, also be made and recorded for each donor.

Method and Technique of Blood Transfusion.—It is generally agreed that for nearly all purposes the citrate transfusion is the simplest and best. Some question has been raised whether the injected red blood cells in citrate transfusions continue to live and functionate in the new host or whether they soon disintegrate. If the blood is immediately injected after it is withdrawn from the donor and citrated, the red blood cells continue, no doubt, to functionate as a part of the circulating blood of the new host. The same holds true for the blood plasma. It is only

if the blood is kept as an available supply in the ice-box for days, as is occasionally recommended for emergency purposes, that the red blood cells and the blood plasma are changed and lose most of their value as homologous living tissue. The blood will then not serve the purpose for which it was intended.

The amount of sodium citrate to be used seems to vary with different operators. In the strength of 0.2 per cent of sodium citrate in the final mixture (1 part 2 per cent solution of sodium citrate and 9 parts of blood) the blood will frequently clot at the time of withdrawal and give considerable difficulty at the time of injection. This was the strength originally recommended by Lewisohn. The circular from the Surgeon General's Office recommends 0.7 per cent sodium citrate. Since an excess of the citrate has been claimed to be toxic, it will be found advisable to use an amount slightly above the one necessary to prevent coagulation and thus obtain a sufficient margin of safety. The writer recommended more than four years ago the use of a 0.33 per cent citrate strength. He adds to each cubic centimeter of a 10 per cent solution of sodium citrate 30 c.c. of blood. The greater concentration of the original citrate solution also avoids an unnecessary dilution of the blood to be injected.

The technique of the citrate transfusion has been thoroughly standardized in the Army, and it will give, as a rule, quite satisfactory results. The apparatus which has been devised and is available for use in the base hospitals seems to be very good and fulfils all the requirements for convenience and accuracy.

Amount of Blood To Be Transfused.—The amount of blood should not be large in the cases considered here, unless we are dealing with a secondary hemorrhage or an intense degree of anemia. Generally, from 250 to 300 c.c. of blood will be found sufficient. Such transfusions avoid the danger of suddenly throwing upon the circulation an excessive burden, to which the frequently degenerated heart muscle may not readily adjust itself. The transfusion may have to be repeated several times. It becomes necessary, therefore, to avoid cutting down upon the veins when doing a transfusion. There is in fact very seldom any reason for the operator to cut down upon the vein of an adult, except under very unusual circumstances. Indeed very few adults will be found whose veins cannot be made sufficiently prominent by a properly applied tourniquet. One sees from time to time patients coming to base hospitals who show ugly scars at the bend of the elbow, following exposure of the vein for purposes of blood transfusion. Unless these operations were carried out as an extreme emergency, they seem to be rather unjustifiable.

Repetition of Blood Transfusion.—This would depend to a large extent upon the special indications in each case. The progress of the

wound, the hemoglobin content, and especially the general condition of the patient are good criteria to go by. The intervals between the transfusions would ordinarily be from 7 to 14 days. One important factor, which is not always considered, should be borne in mind. The blood of one donor may be much more suitable for a patient than that of another one. For that reason, also, the transfusion should be repeated, if the progress of the patient is not as satisfactory as could be desired after one transfusion, with the blood from another donor.

Studies of the Effects of the Blood Transfusions.—Special studies should be made and careful records kept of the effects of single and repeated blood transfusions in these cases of subacute sepsis associated with war wounds and infected compound fractures of the limbs. The tabulated reports from the different base hospitals in these groups of cases would soon offer valuable data by which to gauge the exact value of the limb and life-saving effects of such transfusions.

Summary and Conclusions.—1. Blood transfusions should be used more extensively on the wounded soldiers in the base hospitals.

2. Officers should be especially assigned to this work in the different base hospitals and base hospital centers, whose sole duties would be in connection with the performing of transfusions, consultations on surgical and medical cases and the keeping track of suitable donors.

3. The special indications considered here are subacute sepsis, associated with extensive suppuration or with infected compound fractures, with anemia and emaciation of varying grades; also as a prophylactic measure in enfeebled individuals before severe operations and in cases of postoperative surgical shock resulting from extensive loss of blood during an operation.

4. Large pockets of pus, suppurating joints or extensive empyemas must, of course, be freely incised and drained. No blood transfusion will help in the elimination of these sources of continuous reinfection, unless they are carefully watched for and taken care of as they arise. Autopsies often bring to light such complications, which should have been taken care of while the individual was still alive.

5. The transfusions should be of moderate amounts of blood, from 250 to 300 c.c., and repeated, if necessary, every 7 to 14 days.

6. Systematic efforts should be made to find these patients in the base hospitals. Special studies should be made and careful records kept after the transfusions, so as to obtain as soon as possible tabulated data that will help in more definitely indicating the value of blood transfusion in cases of subacute sepsis associated with extensive wounds and fractures.

TRENCH NEPHRITIS AT A BRITISH GENERAL HOSPITAL IN FRANCE*

By Captain REGINALD FITZ
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(With four illustrations)

INTRODUCTION

DURING the war an abundant literature upon so-called "trench nephritis" has accumulated in English, French, and German periodicals. Beyond the facts that the disease was relatively common amongs the various troops, that it is of uncertain origin and that it has a typical clinical picture, little is known about the condition. Trench nephritis is best defined in the words of Maj. Gen. Sir John Rose Bradford,[1] as a type of nephritis occurring among soldiers and characterized by the frequent presence of bronchitis and dyspnea, the suddenness of onset of uremic manifestations, the rapid subsidence of well-marked renal dropsy, the rarity of occurrence of inflammatory complications, and an extraordinarily low mortality.

It has been the writer's privilege to act as a medical officer at British general hospitals in France since June, 1917. The following observations on trench nephritis are reported, in order to present further evidence illustrating the peculiarities of this disease as seen in British general military hospitals during this time.

STATISTICAL STUDY

At the outset a statistical study of the cases admitted to one hospital during the summer of 1917 was undertaken in order to determine: (1) The relative frequency of this type of nephritis among the medical casualties, (2) the age of nephritic patients as compared with patients with other medical casualties, (3) whether relatively new and untrained troops were more susceptible to nephritis than older and more seasoned soldiers, and (4) whether evidences of an epidemic form of the disease could be discovered.

To determine these points the hospital admissions were divided into medical and surgical cases. The medical cases included all such as are ordinarily received in the medical wards of a civilian general hospital. The diagnosis of trench nephritis was made in cases with a history or physical findings of sudden dyspnea and edema, confirmed by finding of albumin and casts in the urine.

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* From the Medical Division, U. S. Army Base Hospital No. 5.

[1] Maj. Gen. Sir John Rose Bradford. Quart. J. Med., 1915, ix, 125.

Cases diagnosed hematuria or albuminuria without the association of other nephritic symptoms were omitted. The surgical cases included wounds, gas poisoning cases, and such surgical conditions as sepsis, hernia, and genito-urinary diseases. Borderline cases were arbitrarily classified. Otitis media was considered a medical casualty, as was unoperated appendicitis. It seemed best to include the latter disease in the medical category since many patients were admitted with the history and clinical manifestations of mild appendicitis, which cleared up promptly after a few days' rest. Cases of hemorrhoids, on the other hand, were grouped among surgical diseases, although many were not severe enough to indicate operative treatment. The medical cases were tabulated, and the age and length of time spent in France were recorded. To discover possible epidemic foci of nephritis, it was attempted to trace all the medical cases, as nearly as possible, to their original positions in the line. It was impossible to obtain accurate information in this respect. However, the usual itinerary of a sick patient from the front to the base was through a field ambulance, whence in turn he was directed through a casualty clearing station. So far as possible a record was kept of the different field ambulances through which the patients passed.

FREQUENCY OF TRENCH NEPHRITIS

The frequency of trench nephritis as a medical casualty is shown in Table I.

TABLE I

	Medical cases	Trench nephritis	
		Cases	Per cent
June, 1917	589	24	4.1
July, 1917	414	21	5.1
August, 1917	530	28	5.3
September, 1917	727	35	4.8
Total	2,260	108	Av. 4.8

It is apparent from this table that between 4 and 5 per cent of all medical casualties were due to trench nephritis, as determined from the histories and from routine physical examination. No obvious case of chronic nephritis with persistent hypertension and cardiovascular changes was encountered. Unfortunately, comparable statistics from other hospitals were not available; however,

Hurst[2] states that an average of 13 male cases of acute nephritis are encountered each year at St. Bartholomew's Hospital in a total of 7,000 patients. If these figures are taken as typical in a general civilian hospital, and the figures from Table I are considered representative of acute nephritis in a general war hospital during the summer months, the striking frequency of the disease among troops is well illustrated.

AGE INCIDENCE

The ages of 2,254 patients were tabulated in five-year periods, except that a single group was made for patients less than twenty years old and another group for patients over forty. In order to compare most readily the nephritis cases with all others the figures were reduced to ratio per 1,000. The findings are shown in Table II.

TABLE II

Age	General medical cases		Cases of nephritis	
	Actual number	Per 1,000	Actual number	Per 1,000
Under 20.....	170	75	5	46
20–25.....	665	295	18	167
25–30.....	521	231	25	231
30–35.....	369	164	24	227
35–40.....	268	119	18	167
Over 40.....	261	116	18	148

As might be expected, there were relatively few medical cases among men less than twenty years old. The greatest number occurred between the ages of twenty and twenty-five, and the incidence fell as the ages grew greater. The most obvious explanation for this is that the greatest amount of illness fell among the greatest number of possibilities. Young soldiers were more numerous than old soldiers, and they therefore predominated among hospital patients.

The ages of the nephritic patients did not follow this curve however. As pointed out by Bradford, a certain number were young men, though the majority are in the older groups. Although, on account of the small material, the evidence is by no means convincing, it confirms the work of other writers, notably Starck[3] and Hirschstein,[4] who found the greatest number of cases in men between thirty and forty.

[2] Hurst. Medical Diseases of the War, 1917, Edward Arnold, London, p. 135.
[3] Starck. München med. Wchnschr., 1917, lxiv, 193.
[4] Hirschstein. Berl. klin. Wchnschr., 1916, liii, 1045.

RELATION TO LENGTH OF SERVICE

It was possible to discover the length of service in France in the case of all the nephritis patients and in 2,230 of the general medical patients. For convenience the figures are recorded in six-month periods, and to make results comparable they are stated in actual numbers and in ratio per 1,000.

TABLE III

Length of service in France, months	General medical cases		Nephritis cases	
	Actual	Per 1,000	Actual	Per 1,000
6 or less	918	412	59	546
6–12	567	254	22	204
12–18	338	152	9	83
18–24	237	106	9	83
24–30	103	46	6	55
30–36	66	30	3	28
Over 36	1	0.4	0	0

The general cases were most common among the newly arrived troops and diminished in almost direct proportion to the length of time spent in the field. Two factors probably are accountable: (1) the preponderance of new troops over old; (2) young troops inexperienced in field work are notoriously sensitive to disease of all kinds. The nephritic cases reacted in essentially the same way. There seemed relatively more cases among soldiers who had been in France less than six months and relatively fewer cases among the more seasoned troops than in the general clinic, although the figures are too small for conclusive evidence. Such as it is, it confirms Bradford, who found that many of his cases occurred in men who had been serving from two to five months in France, and disagrees with Hogarth,[5] who found nephritis commoner in those who had been six months or more at the front.

EPIDEMIOLOGY

Since each large group of troops was treated at its own field ambulance continuously, it seemed reasonable to believe that, if nephritis was pandemic, those field ambulances which sent back the greatest number of medical casualties would also send the greatest number of nephritics. If, on the other hand, nephritis occurred in epidemic foci, a few field ambulances might be expected to receive large numbers of cases, and there would be relatively little

[5] Hogarth. Journ. R.A.M.C., 1916, xxi, 372.

diffusion. Of the medical cases, 1,947 were traced to their original field ambulances; 191 ambulances sent cases, one sending 85, and 45 only one case each, the rest sending intermediate numbers. Of the nephritic cases, 77 were traced to their original ambulances; 51 ambulances sent cases, the largest number from any one ambulance being 4. Generally the ambulances sending the greatest number of medical cases also sent the greatest number of nephritics, although the figures were not absolutely parallel. There was no evidence of any epidemic focus of nephritis; the disease appeared in a great number of men scattered over a wide area.

SUMMARY

Taking the statistical study as a whole, certain conclusions are justifiable from the facts observed. Trench nephritis occurred in about 5 per cent of all medical cases in a typical war hospital during the four summer months of 1917, when disease was probably at a low point. An acute type of nephritis was thus strikingly more common than in a civilian general hospital. It did not occur in epidemic foci, but was scattered over a wide area, suggesting that the cause of the disease was common to all troops in the field irrespective of local conditions. The most susceptible troops were the relatively old men who had been in France less than six months. It occurred to a certain extent among the youngest men as well as among those who had been in France from the beginning of the war.

CLINICAL OBSERVATIONS

As it was desirable to make a careful clinical study of trench nephritis, it seemed preferable to follow thoroughly a few cases for a reasonable length of time, rather than to obtain single facts from a large group. Accordingly twenty-two typical cases were selected from the patients admitted to the hospital. They were studied in the following way: At entry a careful history was obtained, and a routine physical examination was made. A form of treatment which could be used constantly in order to make observations on different cases comparable, and at the same time in keeping with current views as to proper therapy of the disease, was employed. A rudimentary diet kitchen was established, making it possible to measure and weigh the daily amount of fluid and solid food. No attempt was made to record the calorific value of the food, but precautions were taken to make sure that the fluid intake was constant and that the diet was low in protein and chlorides. The diet consisted of milk, tea, bread, jam, rice, eggs, and chicken; with added potato, onion and fruit in some cases. Little butter was used

because of its variable salt content; the other foods were cooked without addition of salt.

As a routine, the fluid intake was fixed at 1,500 c.c. per 24 hours. At entry in the most serious cases nothing but water was given for three or four days until the acute and critical stage was passed. In less severe cases 600 c.c. of milk and 900 c.c. of tea or water were given at the outset. From this basis the diet was modified from time to time according to the individual patient's reaction. It seemed best to bleed three patients who had convulsions and to give small doses of caffein to a few others in the hope of establishing diuresis. Otherwise the patients were kept warm and were left alone.

The twenty-four-hour urine was collected in glass bottles, preserved with chloroform, and kept at the bedside. It was measured every day, the gross appearance and specific gravity were noted. The albumin content was estimated by Esbach's method and the sodium chloride content by a modified Volhard titration. The urine was sedimented every other day and examined microscopically. The appearance or disappearance of edema was noted by physical examination and was more accurately followed by the water balance and periodic weighing of the patients. Systolic and diastolic blood pressure readings were made every day or two by the auscultatory method with a Tycos apparatus. Blood sugar estimations were made in four cases by the method of Meyers and Baily,[6] to ascertain if it were increased as has been described in certain cases of chronic Bright's disease. (Since the results were universally and repeatedly negative this analysis was not continued.) Dyspnea has been emphasized as a striking part of the clinical picture and has been associated in certain cases, according to Brown,[7] with a lowering of the alveolar CO_2 tension. It was therefore important to determine whether acidosis was a constant feature in the disease and accountable for this symptom. Van Slyke's[8] method was employed in twelve cases for estimating the alkaline reserve of the blood plasma; McLean's[9] adaptation of Ambard's constant was used as a test for renal function in twenty cases. The latter test gives substantially the same information as the phthalein test of Rowntree and Geraghty[10] and has the advantage of requiring blood urea analysis. The urea in both blood and urine was estimated

[6] Meyers and Baily. Jour. Biol. Chem., 1916, xxiv, 149.
[7] Brown. Brit. M. J., 1916, i, 397.
[8] Van Slyke. Jour. Biol. Chem., 1917, xxx, 347.
[9] McLean. Jour. Exper. Med., 1915, xxii, 212, 366.
[10] Rowntree and Geraghty. Arch. Int. Med., 1912, 294.

by Van Slyke's[11] urease method, aspirating the ammonia into appropriately normal acid with a chest aspirating pump or by water pressure.

Though the cases studied by these methods were few in number, they seemed typical of the disease as heretofore described. Nineteen cases at entry presented a history of less than two weeks' duration; of these patients one had been ill only one day. Three patients were unable to give the date of onset, but did not show signs of having pre-existent chronic nephritis; these probably belong to the acute group. In nineteen cases there was marked dyspnea or orthopnea when they first came under observation. Four cases had a history of sudden or repeated attacks of epileptiform convulsions simulating uremia. Twenty-one patients entered with definite edema. In none of the cases were there inflammatory complications, and none died of nephritis. Thus, taking the group as a whole, the cases belong in Bradford's classification of trench nephritis.

DYSPNEA AND ACIDOSIS

The important features of acidosis in relation to dyspnea, as observed in this series, have been grouped together.

Private W. S. A. entered the hospital on June 20, 1917. One week previously he had suddenly become edematous. At entry he was comfortable, breathing easily , and had no demonstrable edema. Systolic blood pressure was 150, diastolic 75; urine had only a trace of albumin, with a few leucocytes and red blood cells in the sediment. The combining power of plasma for CO_2 was 50 volumes per cent, a reading slightly lower than normal.

Private T. J. entered the hospital on June 15, 1917. A week before entry he woke with swollen face and feet and noticed that his "wind was not so grand" on exertion. At entry he was dyspneic; there was slight edema of the extremities, around the eyes and over the sacrum. Systolic blood pressure was 178, diastolic 110; the urine contained much blood, a little epithelium, and 0.3 per cent albumin. The combining power of plasma for CO_2 was 42 volumes per cent. The last test was repeated four days later when the blood pressure had fallen to 150 systolic and 100 diastolic, dyspnea had ceased and the edema had disappeared, although the urine still contained albumin and blood; the reading was again 42 volumes per cent.

Private E. C. O. entered on June 18, 1917, with a history of edema and dyspnea, which had developed suddenly four days previously. At entry he was short of breath but not orthopneic. There were slight edema of the face and over the sacrum, but not of the legs, a suggestion of ascites, and a few moist râles at the base of each lung. Blood pressure at entry was 152 systolic and 80 diastolic, the urine contained 0.6 per cent albumin and numerous hyaline and granular casts. The blood withdrawn shortly after arrival had a combining power for CO_2 of 48 volumes per cent, slightly more

[11] Van Slyke. Jour. Biol. Chem., 1914, xix, 211.

than in the preceding case, although the dyspnea was greater. Four days later (June 22) the blood pressure had fallen to 150 systolic and 85 diastolic, and the dyspnea had improved, though the urine still contained albumin and casts. A second blood test gave a reading of 55 volumes per cent, well within normal limits.

It might be judged by this case alone that the improvement in acidosis was coincident with disappearance of edema and dyspnea, falling blood pressure and general improvement. These factors were not necessarily related, as is shown by the two following protocols.

Private T. G. entered the hospital on June 23, 1917, with dyspnea of a week's duration. The urine had been examined at the casuality clearing station on June 17 and found negative for albumin. On admission there were slight edema of the face and eyes and no marked dyspnea. The latter developed rapidly, so that three days later he was orthopneic and had ascites, general anasarca and brawny edema of arms, legs, abdominal wall and over sacrum. Inasmuch as the heart was of normal size, of regular rhythm and slow rate, it seemed probable that the dyspnea was not of cardiac origin. The urine had 0.5 per cent albumin and contained many hyaline and granular casts. The blood pressure was 150 systolic and 90 diastolic.

The essential features of the case are grouped together in Table IV.

Table IV

Date	Weight, kilos	Dyspnea	Combining power for CO_2 plasma Volumes, per cent	Blood pressure		Blood urea, gms. per liter	Urea index	Albumin, gms. per 24 hrs.
				Syst.	Diast.			
June 23...	76.0	Marked	47.0	150	90	.....	.....	12.8
July 5....	69.3	None	52.0	120	60	0.332	39	5.5
July 11....	63.0	None	61.0	100	54	0.292	33	3.0
July 25....	63.2	None	48.0	104	52	0.352	53	4.0

As in the preceding case, there was slight acidosis at entry which did not seem accountable for the dyspnea but which tended to disappear as the blood pressure fell, as the edema disappeared and as the albuminuria diminished. However, on July 25, one month after entry, the degree of acidosis was as great as at first, although the patient was nearly free of edema and had no exacerbation of dyspnea. The urea index had risen from 30 to 50, and the excretion of albumin had dropped from 13 grams in twenty-four hours to 4 grams, showing that the kidney condition was much improved.

Private J. L. L. had an indefinite history of onset of symptoms. It is known that five months previously he was in a military hospital with

bronchitis, but without any signs of nephritis. At entry to United States Base Hospital No. 5, in July, 1917, he suffered from dyspnea (although with negative cardiac signs), ascites and marked edema of the legs and sacrum with râles at bases of both lungs without hydrothorax. The chief points of interest are tabulated together in Table V.

TABLE V

Date	Weight, kilos	Dyspnea	Combining power for CO_2 plasma. volumes, per cent	Blood pressure		Blood urea, gms. per liter	Urea index	Albumin, gms. per 24 hrs.
				Syst.	Diast.			
July 3....	70.8	Marked	50	180	80	0.694	19	6.3
July 9.....	68.5	None	53	144	80	0.662	9	5.4
July 15....	67.5	None	52	128	65	0.712	14	7.2
July 22....	64.1	None	54	125	60	0.662	23	3.2

Although the course of nephritis was severe as judged by the increase in blood urea and the low urea index, there was almost no acidosis. The acidosis bore no relation to the symptom of dyspnea and was not coincident with either high blood pressure or renal insufficiency.

The other cases reacted in much the same manner. Taking this series together it becomes evident that slight acidosis as measured by Van Slyke's method is not uncommon in this type of nephritis, but is in no way accountable for the dyspnoea. The cases with severest dyspnea did not necessarily develop the greatest acidosis, nor did acidosis cease as the shortness of breath improved. It seems probable that the acidosis was similar to that which has been described as an accompaniment of chronic nephritis and referable to impermeability of the kidney rather than to overproduction of acids within the body.

CONVULSIONS

The cases in which convulsions developed while under observation presented such a striking clinical picture that they are discussed in detail.

Private R. W. L., 19 years old, entered July 6, 1917, 11.30 p. m. When first seen he was in deep coma, breathing stertorously and having frequent convulsions. The physical examination was negative except for slight edema of the face and over the sacrum. The systolic blood pressure was 150; a catheter speciment of urine contained a trace of albumin and a few hyaline and granular casts. He was given morphia immediately without definite effect. Between 2 a. m. and 8.45 a. m. he had fourteen typical epileptiform fits, each lasting from thirty-five seconds to two minutes. Lumbar puncture was performed but seemed to aggravate the condition. Finally 500 cc. of

blood were withdrawn, after which the fits stopped and the patient made a gradual recovery. It is noteworthy that the patient was never able to give any history. He remembered leaving the trenches and being put on a train, but was unable to tell what happened subsequently or immediately before.

An analysis of blood, on July 7, showed blood urea 0.560 grams per liter, and combining power of plasma for CO_2 as 60 volumes per cent.

On account of the patient's unconsciousness it was impossible to obtain a specimen of urine. The blood findings, however, showed no acidosis and only a slight accumulation of urea, much less than is ordinarily encountered in the uremia of chronic Bright's disease.

On the following day the patient was still comatose, so that no 24-hour specimen of urine could be obtained. A short period test was made according to McLean's method with the following results (Table VI):

TABLE VI

Date, July 8, 1917; time of period, 2½ hours; amount of urine excreted, 190 c.c.; weight, 48.3 kilos; 24-hour rate of excretion, 1,800 c.c.; appearance of urine, high, slightly cloudy; specific gravity, 1.010; sediment, a few hyaline casts. No blood.

	Grams per liter *C*	*Grams per 24 hours* *D*
Albumin	2.00	3.6
Urea	20.00	36.00
Sodium chloride	4.0	7.20
Blood urea	0.552	
Urea index	98.00	

It seemed striking that so nearly a normal kidney function should be associated with a condition suggesting very severe uremia. The kidney allowed the free passage of water, was able to concentrate and excrete urea and chloride, there was not a great albuminuria nor very pathological sediment. The blood, on the other hand, was much as at entry. The blood urea was increased a little, although the urea index was within normal limits.

The subsequent course was uneventful. The edema disappeared at once; the blood pressure fell from 150 at entry to less than 130 in two days; there was never any oliguria; the albumin cleared, although a few casts were always found in the sediment. Repeated tests for kidney function by McLean's method showed an urea index variable but always within normal limits, and the blood urea dropped from 0.560 gram per liter at entry to 0.282 gram per liter some three weeks later.

Three features are worthy of comment. At entry the axillary temperature registered 100.6° which rose to 103.4° by mouth on the following morning; this febrile disturbance was over in three days. Blood culture and agglutination tests for the typhoid-paratyphoid group were negative; there was no leucocytosis.

The spinal fluid was under increased pressure and flowed very freely, but was normal histologically and culturally.

Finally, the cloride excretion in the urine was definitely abnormal. A 24-hour specimen could not be obtained until July 11 (four days after entry); this urine contained little salt. On the following days the chloride excretion increased from 2.00 grams to 11.00 grams per 24 hours a week later, and gradually fell to about 5 grams per day. Although not associated with polyuria or rapid loss in weight, this suggested a "dechlorurination" from preëxistent edema.

Private R. B. L., Canadian, twenty-four years old, entered the hospital on August 10, 1917. He had been taken ill eight days previously, developing swelling of his legs, face and eyes, considerable cough, dyspnea and headache. A specimen of urine analyzed at the casualty clearing station showed large traces of albumin and a few casts.

The physical examination at entry was negative except for dyspnea and edema. The systolic blood pressure was 170. The patient was slightly confused mentally and did not remember events immediately preceding entry. He had three severe epileptiform convulsions in twenty-four hours, relieved by bleeding and morphia.

The blood withdrawn to check the convulsions had a urea concentration of 0.422 gram per liter. A short period test was made seventy-two hours later with the following results (Table VII):

TABLE VII

Date, August 20, 1917; time of period, 72 minutes; amount of urine excreted, 70 c.c.; weight, 69.0 kilos; 24-hour rate of excretion, 1,400 c.c.; appearance of urine, normal, clear; specific gravity, 1,009.

	Grams per liter C	*Grams per 24 hours* D
Urea	13.05	78.25
Sodium Chloride	7.70	10.78
Blood urea	0.322	
Urea index	83.00	

The blood urea was low, the urea index was within normal limits, and the kidneys' concentrative functions for urea and sodium chloride were not markedly diminished as judged in a single specimen of urine.

As in the first case, however, the chloride excretion per 24 hours was definitely abnormal, being very low at first, followed by a large output which in turn returned to a constant. In this case the "dechlorurination" was associated with loss of weight, polyuria and the disappearance of edema.

Sergeant Major H. H. entered the hospital on September 10, 1917. During the previous three weeks he had gradually developed edema, dyspnea and headache. At entry he looked pasty and had slight edema around the eyelids and over the sacrum and ankles. Except for moderate right-sided hydrothorax and slight ascites the physical examination was negative. Blood

pressure was 196 systolic and 110 diastolic; the urine contained numerous hyaline and granular casts, red corpuscles and 0.16 per cent albumin. Shortly after entry he had a severe epileptiform convulsion. A short period test for kidney function was immediately made.

TABLE VIII

Date, September 10, 1917; time of period, 72 minutes; amount of urine excreted, 90 c.c.; weight, 72.7 kilos; 24-hour rate of excretion, 1,800 c.c.; appearance of urine, normal; specific gravity, 1.009; sediment, hyaline and granular casts; epithelium; blood.

	Grams per liter C	*Grams per 24 hours* D
Albumin	0.90	1.60
Urea	9.52	17.10
Blood urea	0.420	
Urea index	37.00	

As in other cases, there was a slight increase in blood urea, though the urine was of sufficient quantity and concentration to suggest that the kidney was not severely damaged. The urea index was 37, lower than in the other cases. However, as it seemed evident that renal function was not alarmingly abnormal, the patient was given morphia and left alone. Two days later he had a second convulsion, which was treated by morphia. Finally, on the third day he had two more severe convulsions; 50 c.c. of blood were withdrawn. The patient had no more fits and made an uneventful convalescence. The blood urea had fallen to 0.275 gram per liter despite the continuance of symptoms. Two weeks later the blood urea was 0.180 gram per liter and the urea index was 150.

In other respects the patient reacted almost as did R. B. L. Systolic blood pressure remained at about 190 for a week and gradually fell to 155. Little chloride was excreted during the first twenty-four hours, but later rose to 14.00 grams per twenty-four hours and then fell to about 8 grams. The patient was at no time oliguric, as judged by the water balance. During the second week, however, while he was excreting large amounts of chloride, he had pronounced diuresis and lost 7.5 kilos. in weight.

Private H., twenty-seven years old, entered September 16, 1917. Ten days before entry he noticed swelling of the legs, puffiness of eyes and breathlessness. He was kept in a field ambulance until he seemed in condition to be sent to the base.

Physical examination was negative except for marked edema of the face, sacrum and ankles. Shortly after entry he had two severe convulsions relieved by morphia. Subsequently he made an uninterrupted convalescence. As in the other cases, the blood urea taken after his fits was slightly increased (0.380 gram per liter), although the urea index was normal. The blood pressure was 188 systolic, but fell very promptly. Excretion of chloride was low at first, but increased rapidly. The patient was evacuated after two weeks, having lost 15 kilos. in weight. The systolic blood pressure was then 120; the blood urea was lower than at entry; the urea index was normal; the urine still contained albumin, blood and casts, although the patient's general condition had much improved.

Taking the four cases together, there are certain striking features. All of these patients developed convulsions within a day

following entry to the hospital, after a fatiguing journey of considerable length and exposure. None had had convulsions before entry and there seemed to be no reason for predicting this complication. In three of the cases the systolic blood pressure was at least 170. While other non-convulsive cases were seen with equally high blood pressure, and one convulsive case occurred with a lower pressure, the association between hypertension and convulsions was noteworthy. Other writers have commented on this fact and Bradford and Schütz[12] go so far as to advocate venesection whenever the blood pressure exceeds 160, claiming that the tendency to uremia is thereby diminished. None of the cases showed a significant accumulation of blood urea with alarmingly lower urea index. Had it not been for the symptoms all would have been considered mild cases if the diagnosis were based on functional studies alone. In all of the cases there was impairment in the 24-hour excretion of sodium chloride, followed by an excessive excretion, suggesting that chloride retention was a feature common to all. From these facts it does not seem probable that the convulsions were "uremic" in the ordinary sense; it is possible that some cerebral circulatory disturbance or localized edema was the underlying cause.

IMMEDIATE REACTION OF TRENCH NEPHRITIS TO HOSPITAL CARE

In all cases, whether with or without such complications as convulsions or pronounced dyspnea, reaction was very similar. At the outset it was possible to distinguish two large groups, consisting of cases which improved immediately, and of cases with a tendency to a subacute or chronic course. In each group, however, the kidney acted functionally in the same fashion, much as in chronic Bright's disease or in acute experimental nephritis. At entry, the patients complained of the same train of symptoms; there was almost invariably a history of sudden onset of dyspnea and edema. Physical examination was negative except for edema of the face, legs and body, less commonly of the serous cavities and rarely of the genitals. Blood pressure was almost always elevated, though in certain cases it was normal or subnormal. The urine contained much albumin, blood, leucocytes, epithelium and casts of every sort. Certain cases seemed to have more bleeding from the kidneys than others, though it was impossible to find convincing evidence that there is an essential difference between cases with marked hematuria and those with little renal hemorrhage. The most common abnormality of function was chloride and water retention with associated edema. If the lesion were sufficiently

[12] Schütz. Deutsche med. Wchnschr., 1917, xliii, 130.

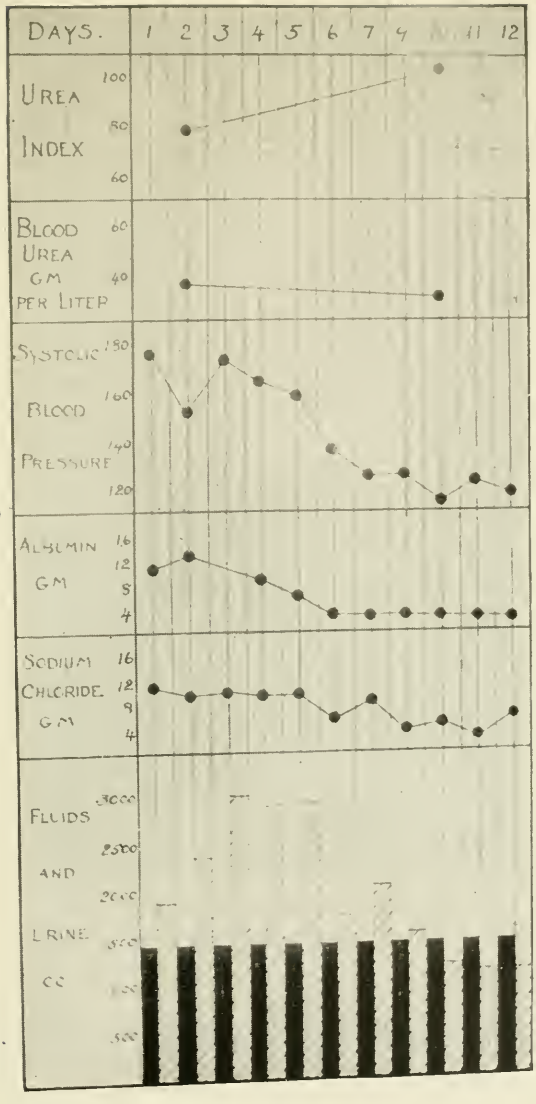


Chart I.

(To face page 93.)

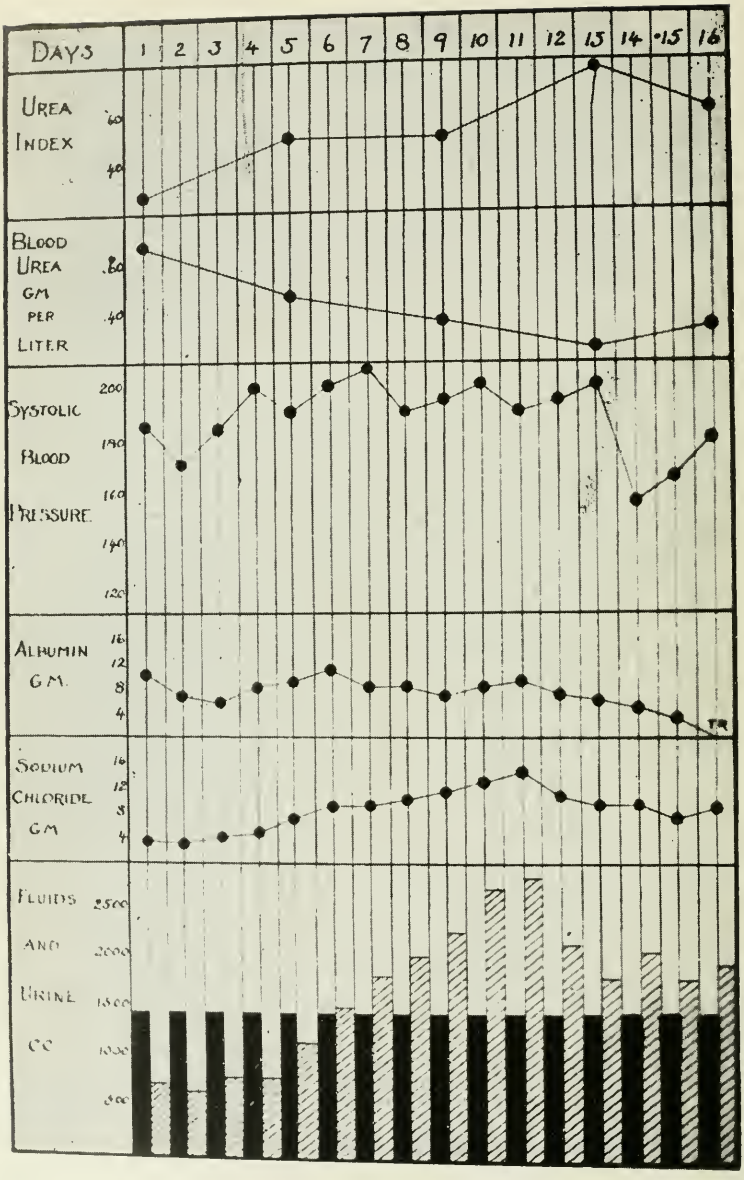

DAYS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
UREA INDEX
60
40
BLOOD UREA GM PER LITER
.80
.40
SYSTOLIC BLOOD PRESSURE
200
190
180
170
120
ALBUMIN GM.
16
12
8
4
TR
SODIUM CHLORIDE GM
16
12
8
4
FLUIDS AND URINE CC
2500
2000
1500
1000
500

Chart II

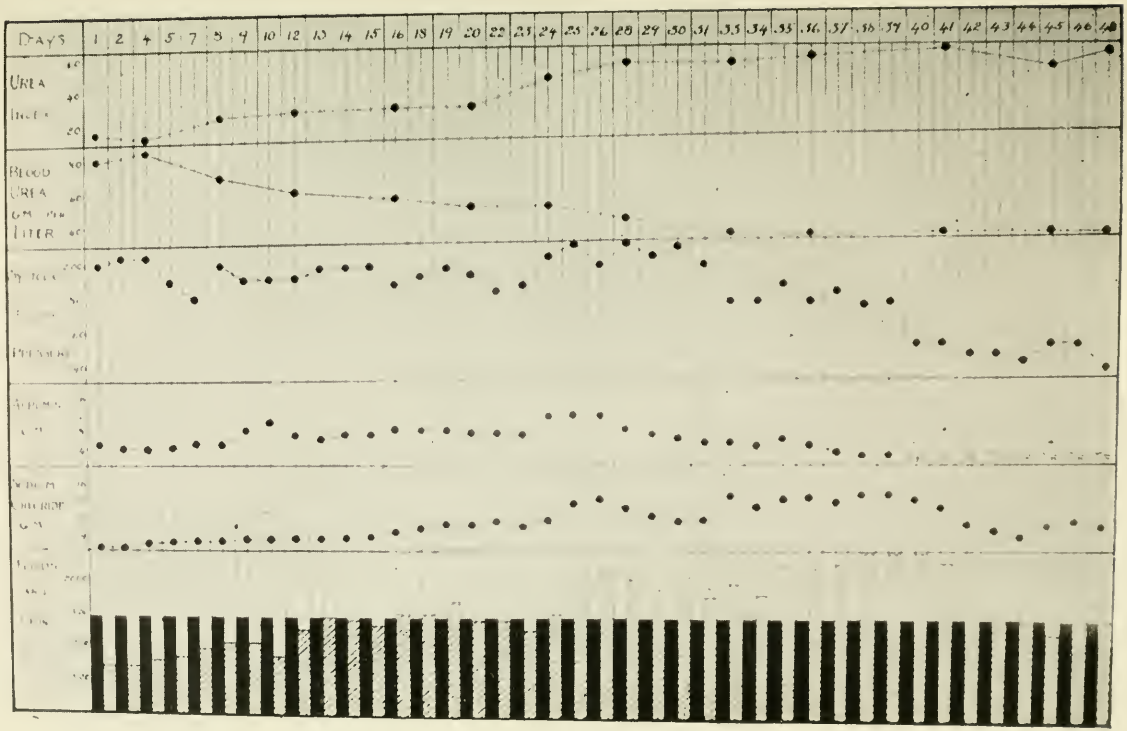


Chart III.

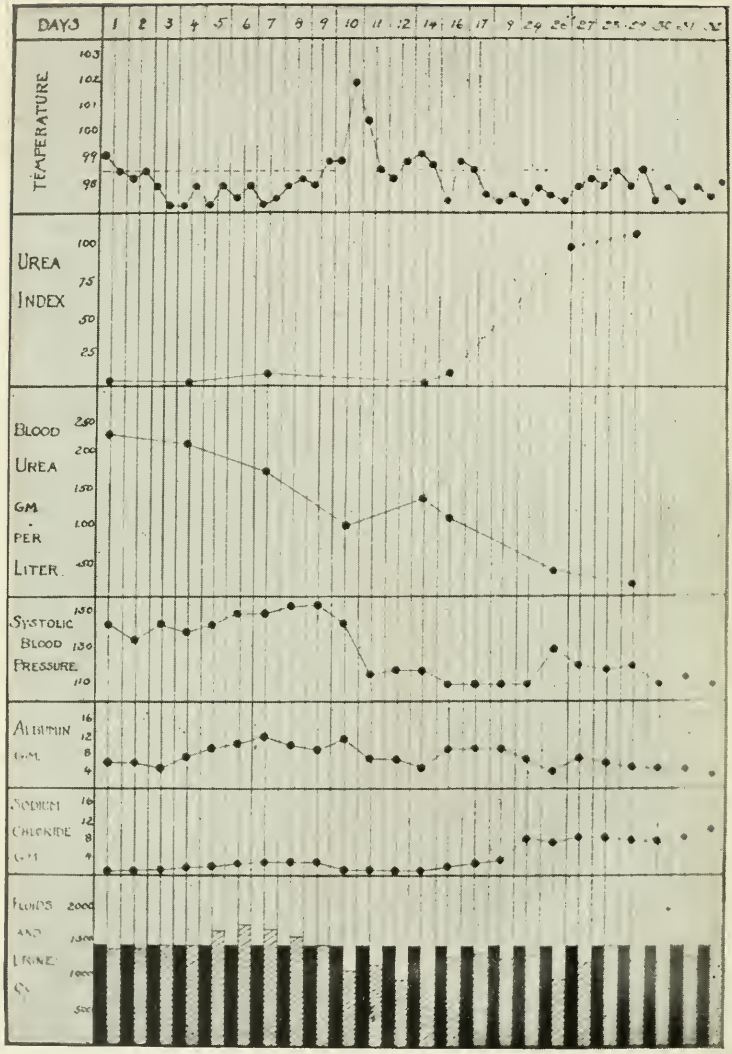

DAYS
TEMPERATURE
UREA INDEX
BLOOD UREA GM. PER LITER
SYSTOLIC BLOOD PRESSURE
ALBUMIN GM.
SODIUM CHLORIDE GM.
FLUIDS AND URINE C.C.

Chart IV.

severe, the blood urea was increased and the urea index diminished. As the acute process subsided the blood urea and blood pressure fell, the albuminuria, hematuria and cylindruria diminished, and the kidney finally became permeable for water and salt. As a general rule excretion of albumin rose at the first signs of improvement and diminished when the most acute stage was past. At first the sediment contained cellular elements rather than casts, later hyaline casts in large numbers, and finally these disappeared entirely. Such a reaction suggested acute congestive nephritis, followed by desquamation, exudation, and eventually healing.

Three cases are cited to illustrate these features and to show the similarity of a mild, a moderate, and a severe case.

(See Chart I)

Private J. B., forty years old, entered the hospital on September 9, 1917. About a week before entry he had attacks of dull headache, swelling of the face and body and increasing dyspnea on exertion. Physical examination was negative except for edema of face, ankles and sacrum. The systolic blood pressure was 176 and the diastolic 90. The urine at entry had much albumin, blood, and relatively few casts.

As soon as the patient was put to bed and given restricted fluids there was pronounced and rapidly increasing diuresis, with establishment of normal water balance as the edema disappeared. The chloride output was high at first, later falling. The excretion of albumin increased during the first few days and fell off as the nephritis diminished. The blood pressure fell rapidly to normal. The blood urea was at no time much increased, but fell slightly, and the urea index, within normal limits at the first observation, rose after ten days.

(See Chart II)

Private P. J. W., thirty-three years old, entered the hospital on October 2, 1918. Except for measles and mumps in childhood he had always been well. During two and a half years of army life he had never reported sick. About September 20, 1918, he noticed swelling of his feet and face, dyspnea on exertion, and slight headache, without nausea or vomiting. He worked for six days after the onset of symptoms, but eventually was forced to give in. Physical examination was negative except for increased blood pressure (185 systolic and 95 diastolic) and for edema of the face, hands, sacrum and ankles. The urine contained albumin, blood and casts.

As can be seen from the chart, the findings were essentially those of the first case, except that the lesion seemed severer and the reaction slower. There was definite oliguria for four days, followed by diuresis reaching its height eleven days after entry, and persisting to a slight extent until discharge. The chloride output was low at first, but increased steadily with the water excretion and eventually approached a normal balance. The excretion of albumin was equally typical. With the beginning of improvement it increased, but later fell until traces only were excreted. The blood pressure remained persistently elevated, though on the last three days it tended to become lower. The blood urea concentration fell steadily, and at the same time the urea index rose from less than 30 to over 60.

Private W. F. C., thirty-four years old, entered the hospital on January 21, 1918. About three weeks before he noticed dyspnea, edema of the face and ankles, and a persistent headache. He carried on for two weeks and a half, but finally had to give in. Physical examination was negative except for hypertension (systolic blood pressure, 200; diastolic, 90) and for marked edema of the face, legs and trunk.

Here again the findings were those of the other two cases, except that the process was slower. The patient was oliguric for twelve days and had no outspoken diuresis until the twenty-fifth day after entry. At the end of seven weeks in hospital he was still excreting more fluid than he was taking in, though he appeared to be free from edema.

At first he excreted only traces of chloride, but as the nephritis subsided and the diuresis developed he put out large amounts. The excretion of albumin rose at first and then diminished. The blood pressure was high for about a month, but later returned to normal. The blood urea fell after a slight initial rise and the urea index, at first very low, rose steadily.

PROGNOSIS

The most effective means for the immediate prognosis of trench nephritis seemed, as in chronic Bright's disease, the determination of the blood urea concentration or preferably the urea index, since the cases with a high blood urea and low index were always more severe than those with a low blood urea and normal index. Although no fatal cases were encountered, it is reasonable to believe that very high blood urea findings would occur with or without terminal convulsions and coma. The ultimate prognosis is less certain. By a "follow-up system" of letters it was possible to keep track of nineteen patients for periods up to fifteen months after the onset of illness. The results are tabulated according to the height of the blood urea concentration at entry. (Table IX.)

The patients were kept in hospitals for periods varying from five weeks to more than ten months before recovery took place. However, ten of them appeared to get over their nephritis entirely after prolonged rest and treatment, and only three were invalided out of the army as unfit. One patient died, but without any signs of nephritis; unfortunately no autopsy was performed. None of the cases seemed to show any chronic progressive downward tendency nor to be suffering from anything more than slow acute nephritis which was gradually subsiding. It seems justifiable to believe, therefore, that the disease, though a true nephritis, is mild and self-limiting, and that complete recovery occurs in the majority of cases. No relationship is demonstrable between the apparent severity of the disease at onset, as judged by blood pressure, urea accumulation or clinical symptoms, and the length of time necessary for recovery.

TABLE IX

Name	Age	At entry		Duration of symptoms before entry	Length of hospital treatment	Disposal and notes
		Blood pressure	Blood urea gm.per liter			
G. B.....	40	166–90	1.34	1 week	3½ months	Still in hospital. Blood pressure 150. Urine has albumin. Slight persistent edema. (Not heard from since last note.)
A. E. W...	35	160–80	1.22	2 days	5 weeks	Well since discharge. No signs of persistent or chronic nephritis. (Heard from 12 months after onset of illness.)
W. F. C..	34	200–90	.82	3 weeks	10 months	Still in hospital and improving slowly. (Not heard from since last note.)
J. L. L...	36	180–80	.69	Unable to state	4 months	Invalided from army for chronic bronchitis. At discharge from hospital no evidence of persistent or chronic nephritis. (Not heard from since last note.)
R. W. L..	19	127–70	.55	1 day	3½ months	Perfectly well. No evidence of persistent or chronic nephritis. (Not heard from since last note.)
R. G. L...	24	172–100	.42	8 days	5 months	At discharge—Blood pressure 120–85. No albuminuria. Occasional cast and red blood corpuscle in urine. No evidence of persistent or chronic nephritis. (Not heard from since last note.)
H. H.....	34	196–110	.42	3 weeks	3½ months	Complete recovery from nephritis. Died 9 months after onset of nephritis from broncho-pneumonia. No autopsy. (Statement from patient's wife and officer in charge of case.)
H. H.....	27	188–90	.38	10 days	4½ months	Complete recovery. No evidence of persistent or chronic nephritis. (Heard from 14 months after onset.)
H. G. B..	39	174–94	.38	1 week	4 months	Complete recovery. No evidence of persistent or chronic nephritis. (Heard from 15 months after onset of illness.)
F. J.....	22	146–95	.36	1 week	2 months	Still in hospital but feels well and appears to be improving. (Not heard from since last note.)
J. B.....	40	176–90	.34	1 week	3 months	At discharge from hospital, no edema. Urine shows trace of albumin. (Not heard from since last note).
T. G.....	29	150–90	.33	1 week	6 months	Urine still has trace of albumin, but no blood or casts. (Not heard from since last note.)
J. N. P...	27	148–92	.30	2 weeks	4½ months	Complete recovery. No evidence of persistent or chronic nephritis. (Heard from 14 months after onset of illness.)
J. W.....	36	160–90	.30	3 weeks	?	Complete recovery in nine months. (Heard from 9 months after onset of illness.)
E. W.,...	27	128–86	.12	2 weeks	3½ months	Still has albumin in urine but no edema. Blood pressure not elevated. Apparently progressing favorably. (Not heard from since last note.)
T. J.....	33	178–110	.....	1 week	6 months	Invalided from army but at work and feeling well. No evidence of chronic or persistent nephritis. (Heard from 15 months after onset of illness.)
E. C. O...	36	152–80	.....	4 days	4½ months	Complete recovery. No evidence of persistent or chronic nephritis. (Heard from 15 months after onset of illness.)
W. S. A..	21	150–75	.....	8 days	5 months	Complete recovery. No evidence of persistent or chronic nephritis. (Heard from 6 months after onset of illness.)
A. E. P. .	24	146–84	.....	10 days	6½ months	Discharged from army. Urine contains albumin and casts. Can do light work but has not recovered entirely. (Heard from 15 months after onset of illness.)

ETIOLOGY

The cause of the disease is unknown despite a mass of conflicting and indefinite evidence. In the majority of cases in this series, an infectious origin is suggested: seven patients entered with fever, the temperature returning to normal as the nephritis improved; in

thirteen others fever developed during the stay in hospital, without physical signs; four cases showed definite febrile relapses. Keith and Thompson[13] have also called attention to the relapsing tendency of this type of nephritis.

Two types of relapse were encountered, one not associated with any demonstrable change in kidney function but accompanied by the typical shin pains of trench fever, the other showing impairment in renal function during the period of fever. A case illustrative of the latter type is quoted.

(See Chart IV)

Private P. N., thirty-two years old, entered the hospital on October 2, 1918. Remembered no serious illness; during nearly two years of army life he had reported sick only once and then had not been incapacitated for duty.

About two weeks before entry he noticed that his eyes were swollen in the mornings and a few days later swelling of the feet and ankles. At the same time he became increasingly short of breath on exertion and had considerable headache. He was admitted to a casualty clearing station, from which he was transferred to the base hospital. Physical examination was negative except for marked edema around the eyes, face, ankles and sacrum, and moderately increased blood pressure (145 systolic, 100 diastolic). The striking features of his case are shown on Chart IV.

At entry there were slight increase in temperature, a low urea index, high blood urea; urine was being passed in good quantity and contained considerable albumin and little salt. For the first few days he improved; the temperature became normal; the urea index rose; the blood urea fell; the blood pressure readings remained almost stationary; the excretion of water, albumin and chloride increased satisfactorily. On the ninth day, however, he apparently had a true relapse, shown by a "spiked" rise in temperature (with return to normal in five or six days), by a falling off in urine output with diminution in the chloride and albumin excretion, by a lowering of the urea index and by a rise in the blood urea concentration. Clinically, too, the man seemed worse, as evidenced by increased dyspnea, a return of headache, and concomitant nausea and malaise.

After the fever was over the nephritis tended to heal and the man was discharged convalescent. The blood urea fell rapidly to normal, the urea index rose, there was an initial rise in the excretion of albumin followed by a fall, the sodium chloride excretion increased, and there was a tendency for the excretion of water to rise, though the patient was evacuated before any outspoken polyuria occurred. The blood pressure fell rapidly when fever developed and remained low afterwards.

TREATMENT

The immediate treatment of the disease as outlined was logical and efficacious. Since water retention, chloride retention and urea retention were all demonstrable, restricted intake of fluid, chloride and protein was indicated. An important feature of this simple

[13] Keith and Thompson. Quart. J. Med., 1918, xi, 229.

treatment is the insistence on absolute system and regularity in feedings. Each patient was regularly given the same amount of fluid at the same time each day. Food was added cautiously and according to established routine. In this way, it was thought, any undue stimulus to metabolism was avoided, and the damaged kidneys were given a chance to become readjusted. Sweating and purgation were not attempted because the cases did so well without such uncomfortable measures. Diuretics were tried in a few cases but with most indefinite result. Alkalies did not seem indicated, as the acidosis was never sufficient to produce symptoms.

Bleeding proved very effective in the cases with convulsions. It must be mentioned, however, that the patient from whom 50 c.c. of blood were withdrawn responded as well and quickly as another from whom 1,000 c.c. were removed.

On the whole this simple treatment at the outset gave gratifying results. Since the cases required hospital care for intervals up to ten months from the onset of symptoms, it would seem that the ultimate treatment is equally important. The patients should be treated and managed as cases of chronic nephritis until all evidence of the acute process is over. They should not be discharged from the army nor be considered hopelessly ill until they have been under observation for a long time.

CONCLUSION

Trench nephritis is a type of acute nephritis of unknown origin occurring among troops. It is characterized by the rapid subsidence of well-marked renal dropsy, the frequent presence of bronchitis and dyspnea, the suddenness of onset of uremic manifestations, the rarity of occurrence of inflammatory complications, and by an extraordinarily low mortality.

It accounts for about 5 per cent of the medical admissions to a general war hospital and is strikingly more frequent than acute nephritis in a general civilian hospital.

It occurs most commonly among relatively older soldiers who have seen service for short periods of time. It occurs to a less extent among the younger and more seasoned troops. It appears to be pandemic and not limited to any single group or groups of soldiers.

The dyspnea is not due to acidosis, though slight acidosis is common. Urea retention is found in the majority of cases and is most marked in the severest. The edema is intimately related to chloride retention and is independent of high blood pressure, albuminuria, or urea retention. Epileptiform convulsions occur in rel-

atively mild cases without markedly abnormal kidney function and are not associated with urea retention, oliguria, or anuria. Cases complicated by convulsions usually have hypertension of varying degree, and all show more or less chloride retention. It is possible that the convulsions are not "uremic" in nature, but depend upon some circulatory disturbance or cerebral edema.

Fever at onset in seven cases suggests an infectious origin, an impression confirmed by the tendency to relapse. Two types of relapse are encountered, one febrile in character and associated with symptoms of trench fever, the other having in addition to fever a definite impairment in renal function.

The immediate prognosis of trench nephritis is most accurately obtained by determining the accumulation of urea in the blood and the urea index. These vary from normal in direct ratio to the patient's condition, tend to approach normal as the albuminuria and hypertension diminish, but are independent of edema and chloride retention. The ultimate prognosis of the disease is less certain. No relationship is demonstrated between the apparent severity of the disease at onset (as judged by functional tests, physical signs and clinical symptoms) and the length of time necessary for recovery.

The indications for treatment depend upon the abnormalities in function. As edema is associated with chloride and water retention, and the severer cases with urea retention, it is reasonable to restrict fluid intake and to give diets low in chloride and nitrogen.

When the blood urea concentration has become normal and the edema has disappeared, cases should be managed as cases of chronic nephritis and observed carefully until they are well.

SOME OBSERVATIONS ON THE SUSCEPTIBILITIES OF THE RECRUITS TO DISEASE

By Lieutenant Colonel GEORGE DRAPER

Medical Corps, United States Army

THE following report embodies the results of an investigation of the pneumonia at Camp Funston during April and May, 1918. Immediately after a severe dust storm about a month before this study was begun, there had been a large number of cases diagnosed as influenza, many of which developed pneumonia secondarily.

There seemed to be little doubt in the minds of the physicians who had seen the cases that the malady in question was true influenza. The clinical picture was typical, and the course of the epeidemic wave followed the usual sharp curve so characteristic of the disease. Bacteriological studies, however, had not been made consistently with special reference to the epidemic, though it was reported that on many of the blood agar plates taken from cases by throat swab, to determine whether or not the *Streptococcus hemolyticus* was present, there appeared frequently numerous small colonies of Gram negative bacilli.

It seemed advisable, therefore, to prepare to make a careful study of any new cases that might develop, both by throat swab and blood culture. After a preliminary survey of the situation the following report and plan for procedure was presented to the division surgeon, and by him to the Commanding General.

Abstract of Report

1. There is a minimum of cases of primary fixed type pneumococcus pneumonia.

2. There is much pneumonia, however, with a varied bacteriology, chiefly Pneumococcus Type IV (bile soluble) and *Streptococcus hemolyticus*.

3. Further study of this confused bacteriology appears futile at this time, because here, as well as at other camps, much excellent work has demonstrated the same confusion of organisms in cases clinically recognized as pneumonia.

4. Recently there has been at this camp a large number of cases, showing a striking clinical similarity, which have been called "Influenza." This term implies the presence of *B. influenzae* and is therefore confusing because that organism has not been shown to be the causative agent. The term "X" Disease is therefore temporarily substituted.

5. The symptoms of the malady are: Sudden onset of feeling "all in," *i.e.*, prostration; headache, aching bones and muscles; chills and fever from 99.5° to 102° or 103°. There is striking absence of pharyngitis or other involvement of the respiratory mucosa. Most of these cases recover in 48 hours. The more severe ones, whose temperature is 102° or more, seem to be those which subsequently develop pneumonia.

6. Outbreaks of this malady apparently follow fatigue and exposure to high wind and dust. Note in this connection the experience of Co. C, 355th Infantry, which follows.

Company C, 355th Infantry, received about the end of March 172 new men from their three weeks' initial stay at the incoming detention camp. On April 8, cases of "X" Disease began to appear among the men in increasing numbers. On April 10, drill work for the company was cut out entirely and for four days the men were confined to barracks. The accompanying table indicates the course of the epidemic, and the apparent influence upon it of the rest period:

COMPANY C, 355TH INFANTRY

Table Showing Incidence of "X" Disease and its Relation to Fatigue and Rest

Date	*Admissions*	*Company activities*
April 7	0	Regular drill.
April 8	3	Regular drill.
April 9	10	Regular drill.
April 10	14	No drill; confined to barracks.
April 11	8	Do.
April 12	1	Do.
April 13	1	Do.
April 14	2	Do.
April 15	1	Regular drill.

As a demonstration this is striking, but of course is impractical from the military viewpoint. However, it points in the direction of an attempt to strike the proper balance between overwork, which defeats its own intended object of rapid preparation, and the other equally retarding influence of too gentle management.

It is suggested, therefore, that just as laboratory experimentation has been furthered to develop methods of epidemic prevention and control, so there be established a field experiment station, involving a typical training unit for the development of training methods which combine all the elements making for the most rapid production of high military efficiency.

As a result of the experiment of the 355th Infantry, General Wood ordered that the new recruits, who were due at this time, should be given less strenuous training than their predecessors at the Detention Camp. This practically provided the experiment station suggested in the report just quoted. Fortunately a valuable accident provided a remarkably good control element. This was the large-sized draft which made it necessary to provide two main sections, one of 6,500 men, and the other of 3,500, housed under the same conditions but in two widely separated camps, each under a different commanding officer.

While the Drill Schedule provided for the entire draft was the same at each camp, the local commander at each place varied the plan considerably in accordance with his views on the handling of recruits. Both commanders coöperated to the fullest extent with the office of the camp surgeon during the investigation.

The two main points of variance between the management of the men at the two camps were, first, that at Camp Pawnee the recruits

were held two to four days on arrival before passing through the receiving station, owing to the great congestion at that place; and second, the drill schedule at Camp Pawnee was practically cut in half. Furthermore, at this camp there was no heavy fatigue work required of the men in addition to the drill. In other words, at Camp Pawnee the men were broken into their new environment by degrees (this accidental because of the congestion at the receiving station), and they were not worked so hard by one-half as were the men at Camp Republican, where the prescribed schedule was adhered to much more closely. It should be mentioned here that this schedule was in itself much lighter than any previous one had been.

The actual study of the new recruits began at the Receiving Station, where they were watched and questioned at various stages of their progress from the moment of arrival in citizen's clothes to the time of their completion of the fourteen days at the Detention Camp. The trains bringing the men arrived at all hours of the day and night, and many of the men not only said they were, but obviously were, tired by the long journeys in the crowded cars. In the case of the first 6,500 men of this draft no time was lost in sending them through the "system" on their arrival. The process of turning a recruit out of his civilian clothes, washing him, examining him, inoculating him with T. A. B. and smallpox vaccine, and finally equipping him piece by piece till he steps forth completely uniformed consumes two hours and a half. During this time the men are in a constantly but slow-moving line, a large part of the period naked, and are kept constantly on the alert for each new process. It is a very exhausting process at any time, but especially so at the end of a fatiguing journey. Several men each day faint during the procedure. Of course the so-called "psychic effect" of the new experience is usually given as the explanation for these cases, but it all represents the varied expression of strain and fatigue.

To the casual observer it is quite apparent that the physical condition of the men as they file past, stripped, is poor. Many have been office workers or indoor salesmen, and their pale skins and flabby tissues bespeak lack of tone and indicate the absence of any kind of exercise.

From the receiving station the recruits were driven 5 miles to Camp Republican, their new quarters. Many of the men found it difficult to sleep well the first night owing to the strangeness of the place, and because often the onset of the reaction to the two vaccinations had begun.

The orders were that no man should be given any drill for the first twenty-four hours after entering camp, but during the day following arrival there was often much policing of the grounds, and at first, at Camp Republican, the men were set to carrying rock down from the hillsides to make paths in the camp.

Several individuals so occupied on their first day after arrival were stopped in their work and observed. They were allowed to rest until all exertion dyspnea had passed, and then pulse rates were taken. The following table shows the findings (occupation and pulse rate) on men taken at random from several groups: Druggist, 148; bookkeeper, 168; salesman, 128; foundryman, 100; stationary fireman, 132; dishwasher, 120; driver, 122. The above remarks have been made in order to indicate the kind of material which was being handled in the recruit camps and the events which occurred in such rapid succession in the first few hours of the transformation from civilian life to that of the soldier.

The recruits were then followed to the drill field and observed during practically the whole of each day for the next three or four days. In the aggregate the men seemed to be going through with the day's work well. Many individuals were observed, however, who had the hot, slightly bluish-red high color of the person who exercises too hard on the first day of his summer vacation.

On the third and fourth days after arrival men began to report sick, and on May 2, the fifth day after the camp started, there was a great increase in the number of sick. The diagnosis of most of the cases was "Influenza."

The similarity of all these cases was so striking that there was little question that they were of like nature. They resembled, too, the description given of the patients from the 355th Infantry. There was considerable variation in severity, ranging all the way from mild general malaise without fever to extreme forms with temperature even as high as 106°.

Subjectively the patients all complained of headache and great prostration. Very many had pains across the lower part of the chest anteriorly, frequently associated with a sensation of constriction in the throat or larynx. General malaise with "pains all over" was common to almost all, and many were constipated. Pains in the lumbar region were also frequent.

Objectively the patients presented a most characteristic appearance. The face was flushed, often looking fiery red. In addition to the high color, definite puffiness, and in some cases actual swelling of the skin of the face, was present. A particularly constant phenomenon was the puffiness of the soft tissues beneath the supraorbital arches, above the upper eyelid. The lips were swollen and shiny, and in one or two instances patients remarked that their faces were all swollen up and that their heads felt like two. The veins over the scalp were frequently engorged. The buccal and pharyngeal mucus shared in the general congestion of the face and head, but rarely appeared to be the seat of an acute infection.

The lungs in most cases were clear and cough absent. Where there

were fine râles or bronchial squeaks, and a cough, it usually turned out that the patient had had a cold before coming to camp. The heart showed no change. The abdomen was often tender, especially over the liver region. The spleen was easily felt in almost all cases, and frequently was definitely tender.

The temperature varied from normal or 99 in the mild forms to 102°, 103°, 105°, and in one instance 106° in the more severe. The pulse was definitely slow in proportion to the height of the temperature, ranging between 70 and 100 or 110. The respiration not infrequently was labored and irregular, never rapid.

The duration of the acute symptoms was between 36 and 72 hours. Many cases with high temperature cleared up with amazing rapidity when put to bed, with no other treatment than catharsis and a little aspirin. But, following the acute attack, the patient feels weak for several days. Several instances occurred where men who had recovered promptly from the attack fell down or fainted at drill on one of the ensuing days.

Most of the cases occurred on the second or third day after the T. A. B. and smallpox inoculation. Some, however, did not appear till the sixth or seventh day. These delayed reactions were frequent.

Below are given several examples of the disease:

Case 1.—Taylor, Maurice H. Rct. Co. 27, 164th Depot Brigade. April 30, received T. A. B. (1) and smallpox vaccine in the evening. May 1, was drilled in the morning and had lectures in p. m. May 2, drill as prescribed. May 3, began with headache and slight cough, at 10 a.m. In the p. m. general malaise and body pains. Patient says that his face is swollen and that his head feels "like two." He is very flushed, veins distended, and eyes injected and the circumorbital tissues puffy. Spleen palpable and soft like a typhoid spleen.

Case II.—Parsons, Wm. Rct. Co. 27, 164th Depot Brigade. April 29, received T. A. B. (2). May 2, began in the morning with headache, "sore lungs," nose stuffed up, slight cough (had cold on leaving home), constipation. May 3, very intense injection of eyes and face, with puffiness. Felt better in p. m. although he vomited. May 4, pt. much better, eyes less red. Slight cough. T. 99. May 5, recovered.

Case III.—Gruber, Wm. L. Rct. Co. 41, 164th Depot Brigade. May 4, received T. A. B. (2). May 5, lay about feeling badly. May 6, felt badly but went to drill in a. m. In the p. m. felt too ill to drill and again lay down in tent feeling very sick. May 7, admitted to field hospital. Face deeply flushed, eyes puffy and injected. T. 104, P. 100, R. 20 labored. Lungs clear, no cough, spleen palpable and soft. May 8, feels much better. Less red and puffy. T. 108.4, P. 93. May 9, patient sent to base hospital. T. 104, P. 100. Dulness at rt. base post., with slight change in quality of breath and voice. May 10, patient much better. T. 99.4, P. 104, R. 28. Signs in chest cleared.

This is an example of a large group of cases which were sent to the base hospital with the diagnosis of pneumonia. It is interesting to note in this connection that there appears to be some discrepancy between the severity of the acute attack under discussion and the liability to develop pneumonia. Thus of many true pneumonias in the

hospital questioned on this point, many stated that their T. A. B. reactions had been insignificant. On the other hand, all the severe cases of the "X" reaction cleared up with amazing promptness. At most they seemed to develop pleurisy or acute bronchitis. A field hospital was established at Camp Republican, where the cases of "X" disease were put instead of sending them to the base hospital. The patients cleared up remarkably quickly in the tent hospital.

Bacteriological examinations of these cases were made in 21 instances. Blood cultures in all 21 by aerobic method, and by anaerobic method in 17, were all sterile. Throat cultures made on blood agar plates from 17 showed in 15 the normal and usual mouth flora. In one case the *Streptococcus hemolyticus* and in another a doubtful *B. influenzae* were found.

An attempt was made to determine by varied rest periods in different companies whether fatigue, added to the combined typhus and smallpox vaccinations, increased the number and intensity of the "X" reactions. With this object in view, one company, selected at random, was given 48 hours' rest following the second T. A. B. injection. But the subsequent study of the company and its control group, which had had 24 hours' rest, was most unsatisfactory. The men found out that some sort of observation was going on, and the company having 48 hours' rest believed that they had received double the dose. Furthermore, different organizations rapidly developed what might be called a "company style." Some would get the idea that it was bad form to say when they felt sick in answer to a question on the field, etc. Others tended to exaggerate their sensations. The number of sick calls on the two or three days following the injection in each of the observation companies was about the same at Camp Republican, but at Camp Pawnee the 48-hour company had many fewer sick.

A far more striking demonstration of the difference between the two camps is to be found in the following table (see page 106) showing the total sick sent to the base hospital, field hospital, and to quarters during the period of stay at the detention camps.

Most of these cases were of the type described above. Now, what the relation of this condition may be to the appearance of other diseases is difficult to prove absolutely. But it is worthy of note that of the 57 consecutive cases sent to the hospital during the ten days after the recruits came in with the diagnosis of pneumonia, 41 were from the detention camps. At least 10 of these turned out not to be pneumonia, but pleurisy or bronchitis following in the course of one of the "X" reactions.

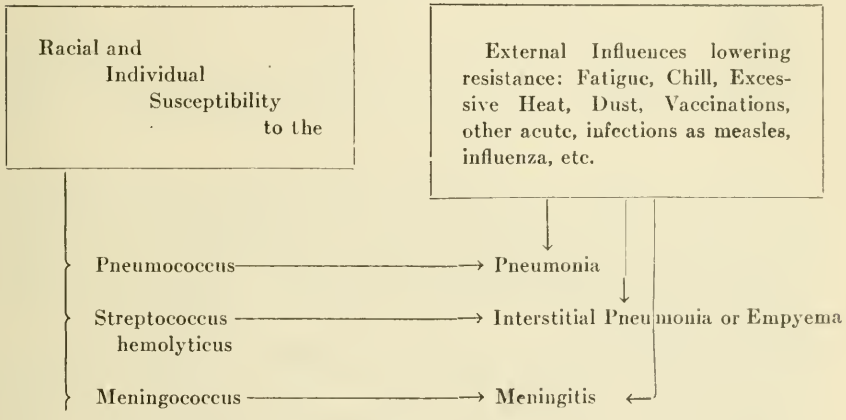
A study of the mouth flora of these 57 cases showed that on admission to the base hospital 42, or 74 per cent, had normal flora, and 15, or

26 per cent, harbored *Streptococcus hemolyticus*. Further complete report on this bacteriological work will be made shortly by Lieutenant Berry, M. R. C.

Two cases of other infectious disease arose in the wake of the strenuous first days and following the "X" condition. One of these was what appeared to be the return of an old gonorrheal joint. Many individuals who arrived with "colds" and coughs were observed to experience aggravations of these minor ailments.

The question therefore naturally arises, "Does the combined effect of fatigue, new environment, and the two inoculation specifics so reduce the recruit's resistance that existing infections flare up and exposure to new ones start the epidemic disease which has killed so many in the past year and so materially interfered with the training program?"

In answering this question the following diagram may be of some assistance in approaching the problem "recruit and epidemic disease," based on the observations recorded above:



It is impossible to measure the importance of any of the factors involved in the above schemes, but there is little doubt that they are all important and all variable. Some of them are susceptible of absolute control. Up to the present time the attention of the medical profession has been directed intensively to the offending germ. No bacteriologist fails to prepare with the greatest accuracy the media on which to grow the organisms he is studying, and it is common knowledge that the minutest change in artificial media will make the difference of a meager or a luxuriant growth. After watching the preparation of recruits it became obvious that little attention was paid by the higher authority to the condition of the human media, notwithstanding repeated and urgent recommendation by the Medical Department.

Date	Republican			Pawnee	
	B. H.	F. H.	Qts.	B. H.	Qts.
April 27	0	.....	.....	.....	.....
28	2	.....	.....	1	.....
29	4	.....	.....	3	.....
30	9	.....	.....	5	.....
May 1	8	.....	.....	3	.....
2	48	.....	27	7	1
3	51	.....	27	3	1
4	8	.....	15	4	1
5	18	.....	10	8	5
6	13	22	24	9	3
7	4	9	4	13	2
8	4	22	7	12	4
9	4	13	5	10	0
10	8	12	4	7	1
11	11	6	8	4	2
12	9	7	4	4	0
13	.....	.....	.....	2	0
14	.....	.....	.....	4	0
15	.....	.....	.....	7	0
16	.....	.....	.....	5	0
	Total: 427, or 6.5%.			Total: 131, or 3.7%.	

RECOMMENDATIONS

(*a*) That recruits be given three to four days on first arriving in camp during which they have no drill or other hard work, and so have an opportunity to "find themselves."

(*b*) That the physical work be developed at a proper rate, as in the training of athletes.

(*c*) That the T. A. B. series and the smallpox vaccination be separated by at least two weeks.

(*d*) That the whole period of inoculation be regarded as one in which the body is being called upon for a severe biological effort. Consequently all other effort, both mental and physical, should be reduced to the minimum.

(*e*) That recruits should not be expected to reach a point where hard work on full time is possible for at least a month. Drafts should be made sufficiently far in advance of the time at which they will be needed as troops, so that this month can be allowed for in the prescribed course of training.

"BLADDER STUTTERERS"

By Captain ROBERT L. HOFFMAN, M. C., U. S. A.
Genito-Urinary Section, Camp Logan, Texas

THE question of nocturnal enuresis in the Army, in contrast to that of civil practice, is one which deals with the young adult rather than the thoughtless child, since enuresis in children is rare after the age of ten years, when the sense of personal pride and the mental attitude tend toward attained correction by proper control of this apparent defect.

The army cases necessarily are those which failed to develop this control through lack of a sense of pride, or other inattention, as the child developed and can be classified into coöperative—those who desire to correct the defect—and the antagonistic, those who are seeking the S. C. D. route from service. There must, of course, be many malingerers, since there is no reason why nocturnal enuresis in the Army should outweigh that of civil life, although the concentration of a great number of men would necessarily make the actual percentage of cases appear higher than would occur in civil practice.

During March, 1917, a true case of nocturnal enuresis was discharged from the service by the S. C. D. route at Camp Logan, Texas, and this case precipitated an enuresis epidemic. These cases were admitted and were very obliging and consistent in their "efforts at nocturnal urination." However, on being called to stand at their beds at 5 a. m. one morning for "pajama inspection," there was a noticeable preponderance of dry pajamas over that of corresponding wet beds, showing a voluntary urination in bed not discomforting to the patient. This, of course, necessitated an effort to classify the true from the malingering enuretic. There are certainly some cases of true enuresis, and these deserve a careful routine examination, complete in each detail. These examinations were uniformly negative of apparent pathological cause for enuresis. True, some cases show a small urinary meatus or a pouchy urethral orifice, but they are foreign to the case, as is the small capillary naevus among "rose spots" on an abdominal wall in typhoid fever.

During the epidemic an intensive treatment was instituted of passing hot sounds, which resulted in a high percentage of admitted cures and a consequent return to duty; the sacral injection of 0.5 per cent sodium chloride solution was also used, with good results, in doses ranging from 2 to 6 c.c.; the technique being surgical antisepsis and the careful location of the sacral foramenae with the point of the needle, then inserting and

turning the needle point up in the long axis of the body, and entering the sacral canal; in other words a sacral "spinal puncture." The danger to the cauda equinae is a minimum one, but should be borne in mind for any extra manipulations after the needle has been inserted. The cases for this treatment are of course selected from the antagonistic class from whom no coöperation can be obtained, and should not be repeated more often than once in five days.

In those remaining cases where the condition exists through the patient's mental inaction but willingness to coöperate, the following method of suggestion has been successfully used and is advocated for all cases of enuresis where the patient desires to attain a cure. As the stuttering, self-conscious person can be so trained that he gradually regains control of irritable muscles of phonation and eventually speaks with but little impediment, so can the enuretic with his "stuttering bladder" soon regain control of the detrusser and sphincter muscle balance.

The procedure is as follows: The patient is admitted, bathed, and given a complete clean outfit before any examination is made. After a careful history is completed he is given a careful examination and a lecture on personal hygiene. He is told the actual condition outlined above, as we see enuresis, and is then put into a standard hospital bed on a regular diet, but cautioned that an excessive fluid intake after 4 o'clock in the afternoon will cause a late frequency of urination which can be obviated by restricting or completely abstaining from any liquid with the evening meal. The absolute absence of any medication is emphasized, since these men have spent their entire lives taking quack as well as ethical treatment. He is warned that, if the bed be wet during the night, the treatment will change to an iron cot with a straw tick in place of the standard bed and mattress, and also that he will be called and compelled to go to the toilet every hour during the night, with a subsequent reward of being called every two, three, four or six hours until he is able to awaken from the symptoms of a full bladder, and so void voluntarily.

The following brief history of one such case, as taken from the records of a series as treated at this hospital, exemplifies the results we have obtained:

Case History.—J. J. C., Reg. No. 21390x, Pvt. Co. 1, Dev. Bn. No. 1. Admitted to Base Hospital, October 30, 1917.

Diagnosis.—Enuresis, Nocturnal congenital nonvenereal old. LOD No. E.P.E.

Family History.—One sister who had nocturnal enuresis, but gained control before the age of twelve years with no treatment.

Past History.—Parents resorted to the professional care as well as the proprietary preparations for the control of this condition; but patient says the only benefit derived was as a result of restricting the fluid intake after 4 p. m. Patient had measles at the age of ten years but noted no effect on the enuresis. Patient ad-

vanced in his school work to the completion of his first year in high school, with no failures.

The physical examination was negative, and the cystoscopic examination revealed no pathology or congenital defect. Microscopic and quantitive examination of the residnal, total, and individual urines gave no clue to a pathological condition. The patient was then instructed as above and put under observation with following results:

Observation.—Standard bed and mattress. First night bed and pajamas wet; second night bed and pajamas wet.

Treatment.—Iron cot with straw tick. Four nights called every hour and sent to toilet; eight nights called every two hours and sent to toilet; three nights called every three hours and sent to toilet. November 18: Bed and pajamas wet at 3. a. m., but awakened in time to regain control. Two nights called every two hours and sent to toilet; six nights called every three hours and sent to toilet.

November 27: Bed and pajamas wet at 2 a. m., but again awakened and controlled. One night called every hour and sent to toilet; one night called every two hours and sent to toilet; four nights called every three hours and sent to toilet; four nights called every four hours and sent to toilet; two nights sleeping all night in iron cot; eight nights sleeping all night in standard bed.

Discharged to duty and at the end of 80 days has had no relapse.

Summary.—(1) Absence of any pathologic lesion for enuresis; (2) the futility of medication; (3) response to psychotherapy.

NOTE BY THE EDITOR.—We publish in the Apri number an article by Capt. Ivy Albert Pelzman, M. C., U. S. Army, entitled "New Cystoscopic Finding in Cases of Enuresis." It seems to us that article printed above is of interest as showing the variety of opinions which exist in regard to a not unusual condition in the service.

EDITORIAL

THE RATE OF TRAINING

"Let us cross over the river, and rest under the shade of the trees."—*Stonewall Jackson.*

The attention of our readers is called to the article on "Susceptibilities of Recruits to Disease," by Lieut. Col. George Draper, M. C., on page 99 of the current number of THE MILITARY SURGEON. The category of "susceptibility diseases" is a concept which has been introduced into medicine by recent experiences in camps and training areas. Long before the recent European war, the problem of the deliberate regulation of the early phases of intensive military training was carefully considered, from the angle of the professional physiologist, by the late Sir Lauder Brunton, in his "Essays on Physical and Military Training" (1898–1915), of which a full account was rendered in THE MILITARY SURGEON (April, 1917, pp. 369–377). As stated, Brunton's conclusions were substantially "that intensive training of miscellaneous groups of men in military camps should be carefully graduated from the start; that, where time presses, large groups of men should be classified according to their relative stamina; and that the exercises should be designed to put many muscles into action by alternate contraction and relaxation of different sets, in order to get maximal results and avoid the possible production of neurasthenics, myasthenics and cardiac defectives, since these people are liable to denounce the whole scheme of training when they leave camp." Observers in our training camps also state that increased susceptibility to certain infectious diseases, particularly the infections to which infancy is liable, may be induced in raw recruits by overexercise, overstimulation, and overwork at the start. It would appear that overtraining may actually reduce some raw recruits to an infantile condition as far as susceptibility to disease is concerned. The large armies necessary for successful military operations in modern warfare have to be recruited from all grades, stations and occupations of civil life, often, as Lieutenant Colonel Draper points out, from "office workers and indoor salesmen," whose "pale skins and flabby tissues bespeak lack of tone" and "the absence of any kind of exercise." Most of our city-bred recruits are, in fact, drawn from this class, but, at the final showdown, the country lad is not much better off, and the city man, when he becomes a husky, usually distances him in ultimate endurance of fatigue and hardship, as also in resistance to disease. The problem, then, is to convert the recruit into a husky in the shortest possible

time. Now, two important facts are brought out by intensive training. One of these, the business feature of outdoor sanitaria and a commonplace of all military training, is that the muscular flabbiness, indigestion, lowered vitality and lowered resistance of the tired-out business man of the cities and the jaded *viveur*, who has trod the primrose path and heard the chimes at midnight, are best corrected, not by the Weir Mitchell treatment, in cotton batting, but by full-time exercise in the open air, for a definite period. The other, a commonplace of all physical training of oarsmen, pugilists, and other athletes, as well as of soldiers, is that such exercise should be graduated and regulated from the start if it is not to defeat its own object. Obviously, the athlete who is trained too rapidly or overtrained at the start will encounter holes in the air, lose his grip, lose his nerve and not get his second wind on occasion.

In the various training manuals, as well as in most of the well-known manuals of military hygiene, ample provision is made for the gradation of physical exercises, the resting of marching and working men and the avoidance of overexertion and fatigue. All that is necessary is that these directions be carried out by commanding officers. Through the courtesy of Maj. William Roberts (Office, Chief of Staff), the following excerpts have been made available:

In the Manual for Physical Training (1914) we find the following:

(Pages 9 and 10)

"The question of the *Physical Aptitude* and *General Condition*, etc., of the men is a very important one, and it should always determine the nature and extent of the task expected of them; never should the work be made the determining factor. In general, it is advisable to divide the men into three classes, viz., the recruit class, the intermediate class, and the advanced class. The work for each class should fit the capabilities of the members of that class, and in every class it should be arranged progressively."

". . . The time of day, too, is important. When possible, these drills should be held in the morning about two hours after breakfast, and at no time should they be held immediately before or after a meal."

(Page 13)

"It should be constantly borne in mind that these exercises are the means and not the end; and if there be a doubt in the mind of the instructor as to the effect of an exercise, it is always well to err upon the side of safety. *Underdoing is rectifiable; overdoing is often not.* The object of this work is not the development of expert gymnasts, but the development of physically sound men by means of a system in which the chances of bodily injury are reduced to a minimum. When individuals show a special aptitude for gymnastics they may be encouraged, within limits, to improve this ability, but never at the expense of their fellows."

"Short and frequent drills should be given in preference to long ones, which are liable to exhaust all concerned, and exhaustion means lack of interest and benefit. All movements should be carefully explained, and, if necessary, illustrated by the instructor.'

"The lesson should begin with the least violent exercises, gradually working up

to those that are more so, then gradually working back to the simpler ones, so that the men at the close of the drill will be in as nearly a normal condition as possible."

(Page 14)

"Never exercise the men to the point of exhaustion. If there is evidence of panting, faintness, fatigue, or pain, the exercise should be stopped at once, for it is nature's way of saying 'too much!"

(Page 15)

"Never exercise immediately after a meal; digestion is more important at this time than extraneous exercise."

Infantry Drill Regulations (1911), Paragraph 625, reads: "With new or untrained troops the process of hardening the men to this work must be gradual. Immediately after being mustered into the service the physical exercises and marching should be begun. Ten-minute periods of vigorous setting-up exercises should be given three times a day to loosen and develop the muscles. One march should be made each day with full equipment, beginning with a distance of two or three miles and increasing the distance daily as the troops become hardened, until a full day's march under full equipment may be made without exhaustion."

Paragraph 630 reads: "A halt of 15 minutes should be made after the first half or three-quarters of an hour of marching; thereafter a halt of ten minutes is made in each hour. The number and length of halts may be varied, according to the weather, the condition of the roads, and the equipment carried by the men. When the day's march is long a halt of an hour should be made at noon and the men allowed to eat."

Cavalry Drill Regulations (1916), paragraph 17, notes that these drills should be frequent but short, and paragraph 35 states that short and frequent drills are preferable to long ones, which exhaust the attention of both instructor and recruit.

Paragraph 96 of Field Service Regulations (1914) states that "while conforming to other requirements, marches are continued so as to reduce to a minimum the hardships of the troops, also, that men are not kept under arms longer than necessary, nor required to carry heavy burdens when transportation is available. Provision for halting on the march (Paragraph 102) and resting during the hot weather (Paragraph 104) evidences the same considerate attitude toward men on military duty, and the conclusion of the whole matter, as far as U. S. Army Officers are concerned, is given in Paragraph 245: "Lack of sufficient rest renders troops unfit for hard work and *diminishes their power of resisting disease.* Therefore, commanders should secure for the troops, whenever possible, their accustomed rest."

In the light of the above, there is evidently no new discovery under the sun and, from the strictly military point of view, Colonel Draper's proposition that the recruit be given three or four days of inactivity in order to find himself in camp, and that full-time hard work is not advisable inside of a month's time, is probably a bit exaggerated. During these first three or four days, the recruit is, in effect, engaged in finding himself in and about the camp, but the time should not be entirely wasted. Setting-up exercises and short marching exertions can surely do no harm. In grading physical exercise in recruits, much, of course, depends upon the climate and sanitary conditions of camp sites, the proper selection of which, in advance, is the first step in the way of military preparedness. The training areas of France were perhaps better

adapted to this end than those of the United States, which has the trying climate of a country somewhat southern in its geographical relation to Europe. Hot, moist and low-lying areas have never been notorious for improving the physical standard of human beings. Given a well-selected camp site, with graduated training in the early stages, your recruit will soon be in position to stand anything.

ASSOCIATION NOTES

The following named officers have been elected to active membership in the Association of Military Surgeons of the United States since the publication of our last list:

U. S. Public Health Service

Asst. Surg. Walter K. Foley

Medical Corps, U. S. N. R. F.

Lieut. Rex H. White

Medical Corps, U. S. Army

Major

Frank Brooke Foster

Captains

Foster A. Beck
Mortin V. Godbey
Arthur G. Heath
Isidore I. Hirschman
James Gilbert Howard
Howard W. Nowell
Elmer Harrison Ormsby
Charles A. Riley
Charles H. deT. Shivers

Captains—Continued

First Lieutenants

John Williams Leo Brennan
Sewell B. Coulson
Thomas Aubrey Dickson
John Edd Furry
Jose A. Hernandez
William Roy Keller
Thomas Junior Nunnery
Albert L. Stubbs
Charles F. Swanson
J. Wiley Thimlar

COMMENT AND CRITICISM

The following extract from weekly Bulletin No. 57 of the A. E. F. is reproduced here as a matter of interest in regard to a question which has been much under discussion. Inasmuch as pneumonia was the same scourge with our forces during the present war that typhoid was during our campaign in 1898, anything which tends to a knowledge which shall diminish either the incidence or fatality of this disease ought to command our respectful attention. It is believed that both the figures and the ratios in the table given would be of interest as well as the explanatory text.

J. R. C.

Encouraging Results

USE OF PNEUMOCOCCUS VACCINE IN BASE SECTION 2

(Report from office of Base Surgeon)

Results of Vaccination against Pneumonia in Base Section No. 2, A. E. F., 26 April, 1919

Place	Number of men		No. of pneumonia cases		Deaths from pneumonia	
	Vaccinated	Not vaccinated	Among the vaccinated	Among those not vaccinated	Among the vaccinated	Among those not vaccinated
Camp de Souge	4,447	5,383	3	2	1	.....
Embarkation Camp:						
Permanent	2,130	427	7	8	.....	.....
Casuals	27,054	25,478	10	26	1	7
St. Sulpice	8,331	2,670	16	40	3	4
Pontenx	2,675	1,075	2	2	.....	.....
Angouleme	69	251	.....	1	.....	.....
Camp Hospital No. 79:						
Casuals	4	10,379	.....	4	.....	.....
Permanent	62	685	.....	.....	.....	.....
Bassens No. 4	732	1,995	.....	.....	.....	.....
Dax	156	776	.....	.....	.....	.....
Camp Hospital No. 104	46	77	.....	.....	.....	.....
Camp Hospital No. 19	143	267	.....	.....	.....	.....
Totals	45,849	49,463	38	83	5	11
Rates per 100,000 strength	.....	.....	83.5	168	10.8	22.2

In the preparation of the above table no cases of pneumonia are counted until one week after the organization has been vaccinated. The number of men in the organization one week after vaccination of some of their number is indicated; for instance, at Camp de Souge 4,447 men who had been vaccinated, and at the same time 5,383 who had not been vaccinated. Since one week after vaccination 3 cases of pneumonia have appeared among the vaccinated and 2 among the unvaccinated.

This same procedure has been adopted for the other camps. No camps have been included in which some vaccination did not occur. From this table it will at once appear that the vaccination had nothing to do with the incidence of pneumonia except in possibly the Embarkation camp and at St. Sulpice. In regard to the Embarkation Camp, it should be stated that many of the casuals had returned to the United States so that complete records are not available. At St. Sulpice this fact should be noted: the composition of this camp is of American soldiers and about 2,500 German prisoners. The American troops were vaccinated during the latter part of February but the German prisoners were not vaccinated. About the middle of March an outbreak of influenza and pneumonia appeared among the American troops and the German prisoners, with the result that there were about 16 cases of pneumonia among the American troops and about 40 cases of pneumonia among the German prisoners, with deaths as indicated. Since that time the German prisoners have been vaccinated. In this connection it should be pointed out that the American troops were protected not only by vaccination but by a certain degree of immunity occasioned by a previous outbreak of influenza and pneumonia.

It would appear from the three months' experience here reported that probably slight protection against pneumonia was offered by vaccination. The table as a whole would indicate that a person who was vaccinated was about half as liable to infection with pneumonia as one who was not, and that a patient who developed pneumonia was about half as likely to die if vaccinated as one who was not vaccinated. The figures in this table would seem to encourage the proposition to try out on an extensive scale prophylactic vaccination against pneumonia next December just before the pneumonia season begins.

Clinical reports from the chiefs of the medical services of the hospitals in Base Section 2 indicate that among the pneumococcus pneumonia patients who had vaccinated against pneumococcus infection, the course of the disease is of a milder character and of a shorter duration.

We quote the following statistics from Weekly Bulletin No. 59 of the Chief Surgeon, S. O. S., of the American Expeditionary Forces, as being of interest to our readers:

INTERESTING TOTALS

1. From June 15, 1917, to February 28, 1919, inclusive, there were 708,335 cases of disease, causing a loss of 8,277,657 days of service.

There were 225,955 cases of traumatism (including all battle casualties), causing a loss of 2,705,588 days of service, or a combined total of 934,290 cases, and a loss of 10,983,245 days of service, or 30,091 years.

2. Of the cases of disease: 90.2 per cent returned to duty, 6.0 per cent were invalided home, 3.3 per cent died in hospital, and 0.5 per cent deserted. Of the cases of traumatism: 73.8 per cent returned to duty, 21.1 per cent were invalided home, 5.7 per cent died in hospital, and 0.4 per cent deserted.

3. The average time in hospital for both classes of cases was 11.7 days per case. Of those reported as deserted many are believed to have left the hospitals to return to the front.

4. Mumps has caused the greatest loss of days from non-effectiveness due to disease. There have been 83,202 cases of mumps, with a loss of 1,000,424 days of service in the A. E. F., from July 1, 1917, to March 31, 1919. There were only 43 deaths from mumps during that period.

5. The greatest number of deaths from disease of all kinds was due to pneumonia. There were 28,292 cases of pneumonia, causing a loss of 622,424 days of service in the A. E. F., from July 1, 1917, to March 31, 1919 inclusive, with 12,361 deaths.

6. Of all deaths in the A. E. F., 32 per cent or 2 in 7 died from disease.

Of total deaths from disease for the period June 15, 1918, to March 31, 1919, inclusive, numbering 17,691, there were—

11,786 deaths from pneumonia, or	66.6	per cent
715 deaths from meningitis, or	4.0	per cent
515 deaths from influenza, or	2.9	per cent
351 deaths from tuberculosis, or	1.4	per cent
143 deaths from typhoid and paratyphoid, or	0.8	per cent
64 deaths from measles, or	0.3	per cent
40 deaths from diphtheria, or	0.2	per cent
29 deaths from dysentery, or	0.16	per cent
27 deaths from scarlet fever, or	0.15	per cent
4,021 deaths from all other diseases, or	22.7	per cent

Of all wounded 1 in 14 died.

7. The average rate of venereal diseases was under 40 per 1000 per year.

8. Total mental diseases including mental deficiency was from June 15, 1917, to April 27, 1919—12,266 cases, of which 8,076 were returned to duty.

9. Total number of cases evacuated from the front, 214,487.

Total number of patients evacuated to the U. S.—to April 29, 1919—119,974.

10. Maximum number of beds with date was 299,835 beds on Nov. 21, 1918. (Including Convalescent Camps, but not Evacuation Hospitals or other Army Units). S. O. S. only.

Maximum number of patients with date was 193,026 on November 12, 1918. (Including Convalescent Camps). S. O. S. only.

11. The maximum number of hospitals centers was 23 on December 5, 1918.

12. The maximum number of Base Hospitals operating at one time was 122 on January 2, 1919.

13. The maximum number of Camp Hospitals operating at one time was 64 on February 6, 1919.

14. The maximum number of Convalescent Camps was 14.

15. Total number of Camp Hospitals operated during entire period was 97.

16. Losses in A. E. F. June 15, 1917 to April 15, 1919, inclusive:

Killed in action, Army and Marines	33,887
Died of wounds, Army and Marines	14,190
Wounded, Army and Marines	201,230
Died of disease, Army and Marines	22,986
Died of other causes, Army and Marines	4,281

17. Among the medical supplies received by the A. E. F. were: Ether, 913,480 pounds; sheets, 3,790,268; foot powder (talcum), 3,024,029 pounds, equal to 1,512 tons; gauze, 107,055,986 yards, equal to 61,338 miles (unrolled it would extend nearly two and one-half times round the world.)

CURRENT LITERATURE

Journal of the Michigan State Medical Society. Vol. xviii, No. 5. Grand Rapids, May, 1919. Victory Number.

This number is devoted, as its name indicates, largely to consideration of those who were in the service of the country during the present war. The issue of the magazine is almost entirely given up to reproduction of photographs of officers of the State of Michigan and should prove a very gratifying number, particularly to the representatives of that State. The only error which we note in this connection is the transposition of the initials of the name of Major General Ireland. The cover of the magazine is attractive and, all in all, it is a good piece of work.

J. R. C.

Modern Medicine. Vol. i, No. 1, May, 1919. Published monthly by the Modern Hospital Publishing Company, Chicago, Ill.

We are in receipt of the first number of the magazine listed above. It is in form of make-up of the same excellent type as the *Modern Hospital*, of which it is in reality an offshoot. The editorial staff assures the seriousness of the publication, and one of the objects of the periodical is that stated in the letter accompanying the first copy which states that "The editorial appeal of *Modern Medicine* will be directed especially to that part of the profession interested in industrial hygiene, public health and current problems in social medicine."

The make-up is attractive and the illustrations ample and to the point. We notice one of the decorations on the front cover is a modification of the caduceus, the winged staff of Mercury. This being the case we suppose that eventually the editors will have to account to the pages of the *Journal of the American Medical Association* for its usage in view of the strictures based on the adoption of this symbol in connection with matters medical.

J. R. C.

BOOK REVIEWS

Diseases of the Heart and Blood Vessels, by Thomas E. Satterthwaite, A.B., M.D., LL.D., Sc.D., Consulting Physician to the Post-Graduate, Orthopedic, Manhattan State and Babies' Hospitals, etc. New York City: Lemcke and Buechner.

Under the above title Dr. Satterthwaite contributes what is, in fact, a revised edition of two earlier works on cardio-vascular diseases, based on the results of observations of a trained clinician. Some of the chapters in the older volumes have, with advantage, made way for the discussion of subjects of more timely interest. Inclusive chapters on general and special methods of diagnosis logically introduce the subject, and are followed by sections on the various cardiac and vascular diseases and disorders. The relation between the circulatory system and the ductless glands has been given considerable attention, with a special chapter on Graves' disease. Such topics as "Cardiac Neoplasms" and "Cardiac Parasites" are concisely discussed, while the important matter of therapy has been treated more fully. Special forms of treatment, *e.g.*, hygienic and dietetic, are rationally evaluated, and nowhere does the physician of large experience lose sight of the patient's individual needs. A chapter on "Surgery of the Heart," by Dr. W. Wayne Babcock, may be especially commended as one of the best contributions to this subject to date.

The author fulfils the promise of presenting his subject with clarity and conciseness, in a style which cannot fail to appeal to the busy physician.

Review of Elementary Bacteriology and Protozoology for the Use of Nurses, by Herbert Fox, M.D., Third Edition, Illustrated. Philadelphia: Lea & Febiger, 1919. Price, $1.75.

In writing a book upon bacteriology and protozoology for nurses, it is evident that it has to be made as brief as possible, consistent with the information that it is desirable that nurses should have regarding these subjects.

A careful examination of this book has shown that the portion devoted to bacteriology fulfils his function and that the descriptions are accurate and easily understood.

Unfortunately, the same cannot be said for the section devoted to protozoology, where many errors are noted, and while it is not supposed that these organisms would be treated fully in a work of this character, there is no reason why what is said regarding them should not be accurate. For instance, in discussing *Endamoeba histolytica*, the statement is made that these organisms are "cultivated artificially with great difficulty," and further, that "only monkeys and dogs" are susceptible to the ameba causing disease in man. The latter statement is inaccurate, as *Endamoeba histolytica* produces disease in cats, and these animals have been more frequently used in experimental work than either monkeys or dogs.

Regarding the statement as to the cultivation of these organisms, there is as yet no positive proof that *Endamoeba histolytica* has been cultivated upon artificial culture medium.

Again, in discussing malaria, the statement is made that monkeys may be artificially infected. So far as the writer is aware, malaria has never been produced experimentally in any animal but man. It is unfortunate that in a work of this character such statements should be made.

The book is well printed and illustrated.

Chas. F. Craig.

HISTORY OF THE WORLD WAR, by Frank H. Simonds. Published for the Review of Reviews Company by Doubleday, Page and Company, New York City. Volumes 1, 2, and 3. Other volumes to follow. Price, $3.50 per volume.

The accepted dictum that histories should not be written until the lapse of considerable time had mellowed the views of the writers and given a better perspective has been consigned to the limbo of discarded theories and rests there with many other traditions which the World War has proven fallacious. With a conflict as far reaching as the one which is in its closing stage it would be folly to allow the many contributing causes, the shifting events and the political lights to become obscure and grow dim under the dust of time before recording them. Even under the vivid light of the present the accurate setting forth of the events of this mighty struggle, the orderly array of cause and consequence, is a task which calls for much skill and an analytical faculty which is not vouschafed to all those who write.

Early in the war, Mr. Simonds compelled attention by his concise analysis of the shifting situation in Europe, and it is not too much to say that his reviews of current events in the theater of war were recognized universally as being the most authoritative of those appearing in the press. What he wrote was not "res gestae," the best interpretation at second hand of matters of fact, but the opinions of a clear-thinking, level-headed man who went, wherever possible, to the source and scene of what he wrote about and told what he saw and knew. This being the case, it is inevitable that his deductions must carry an additional weight over any which depend largely on documentary evidence for their facts. He *saw* many of the things he writes of; he talked with many of the leaders who shaped the events which he describes. This was a material advantage, and no less so, but falling in a category apart, is the fact that he has the trend of mind which enables him to see clearly without distortion, to draw accurate conclusions and to write them in forceful and convincing language.

What he undertakes to do in his history is clearly set forth in his Preface, and the fact that he recognizes the magnitude of the task very frankly is to us rather more convincing as to his ability to cope with it than if he had approached the subject entirely with the air of one who would speak "ex cathedra."

The three volumes thus far published give evidence of the thoroughness with which the completed work will cover the subject. The Introduction by Albert Shaw in the first volume gives a full and scholarly review of the purpose of the work, and points out the special qualifications of Mr. Simonds for the task. The volume itself begins in Chapter I with a review of affairs in Europe between 1871 and 1904, dealing largely with political conditions and their bearing on the final rupture. The last chapter, XII, deals with conditions on the west front from November, 1914, to May, 1915, and between the two we note as chapter headings, "The German Attack," which sets out their strategic conceptions; "Belgian Defense and French Offense"; "The Battle of the Marne"; "The Battle of Lemberg." These comprise Part I of the volume. In Part II we have a series of interpretations of special phases and descriptions of methods and machinery which had a high contributory value in the issues at stake. These are written by experts who were particularly qualified to treat the subjects with which they deal and, as evidence of this, we may quote: "The Russian Conquest of Galicia, by Stanley Washburn;" "Flying Machines and the War, and interview with Orville Wright; by Fred C. Kelly;" and the "Language of the Big Guns, by Hudson Maxim."

Volume II begins with "The New Phase," starting with the recognition by the Germans of the failure of their original plan and the awakening of the Allies to the danger of their position. Chapters III, IV and V are taken up with a discussion of the naval aspect of the struggle. The following chapters, up to Chapter XIV, take up Italy's entrance and follow progress both in the east and the west, with one de-

voted to the Russian collapse and the fall of Warsaw. Part II of this volume is also devoted to discussions by experts on topics of importance, and we note articles by Lord Northcliffe, Sir John Jellicoe, Joseph Chailley and H. J. Elliot.

In Volume III we have a very complete account of the struggle which centered about Verdun and the Somme, and Mr. Simonds is peculiarly qualified to speak on this phase inasmuch as he was present in person and writes of that which he himself knows. Chapter V treats of the Irish Rebellion, the surrender of Kut, the Battle of Jutland and the fall of the Asquith Ministry. The battle of the Somme is dealt with at length, and in Chapter XI the Italian situation is reviewed. Chapter XII gives an account of the last Russian offensive, while subsequent chapters are taken up with the Rumanian *debacle*, the affairs at Salonica and Monastir, and a general review of the campaign of 1916, together with an account of the launching of the first German peace offensive.

Part II contains Mr. Simonds' personal narrative of his trip to Verdun, articles by Viscount Bryce, Henry Morgenthau, Philip Gibbs, Major S. J. M. Auld and others.

The volumes are profusely illustrated, many of the illustrations being in color and a number of them photographic reproductions. The maps are complete and supplement the text thoroughly. The whole work is attractive in appearance and, with its completion by the publication of the remaining volumes, will place at the disposition of those who are thoughtfully interested in the inception, progress and termination of this titanic struggle a most complete and scholarly analysis of the whole great tragedy.

James Robb Church.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interest of our readers and as space permits.

Medical War Manual No. 8.—Military Surgery of the Ear, Nose and Throat, by Hanau W. Loeb, Major, M. R. C., U. S. A. Philadelphia and New York: Lea & Febiger, 1918. Price, $1.25.

The Blind—Their Condition and the Work Being Done for Them in the United States, by Harry Best, Ph.D. New York: The MacMillan Company, 1919.

The Surgical Clinics of Chicago, Vol. iii, Number 2 (April, 1919) Philadelphia and London: W. B. Saunders Company. Published bi-monthly. Price per year: Paper, $10.00; cloth, $14.

La Prothese Fonctionnelle Des Blesses de Guerre, by Dr. Ducroquet. Masson & Co., 120 Boulevard Saint-Germain, Paris, France. 1919.

Lecons de Chirurgie de Guerre. Masson & Co., 120 Boulevard Saint-Germain, Paris, France. 1918.

History of the World War, by Francis A. March, Ph.D., with an introduction by Gen. Peyton C. March, Chief of Staff of the U. S. Army. Philadelphia, Chicago and Toronto: The John C. Winston Company, 1919. Price, $3. net.

The Control of Hookworm Disease by the Intensive Method, by H. H. Howard, M.D. Publication No. 8, The Rockefeller Foundation, International Health Board, New York City, 1919.

INSTRUMENTS AND APPLIANCES

CAMP FUNSTON GARBAGE STAND AND FLY TRAP

(With one illustration)

The following letter, together with the specifications which follow it, are self-explanatory. They need no comment except the possible suggestion that fly time is now upon us and it may be very seasonable material with the object of obviating this ever-present pest and menace.

J. R. C.

HEADQUARTERS CAMP FUNSTON
Office of Camp Surgeon
Camp Funston, Kansas.

April 9, 1919.

EDITOR, "MILITARY SURGEON,"
Army Medical Museum,
Washington, D. C.

SIR:

I am enclosing a cut and specifications of a combined Garbage Stand and Fly Trap, devised and adopted at Camp Funston last year, which proved to be most effective.

Every organization was provided with these stands, which were made of scrap lumber at practically no expense. They added materially to the appearance of the camp and caught a surprisingly large number of flies.

This is offered as a suggestion, as being an effective method of handling garbage and, should you wish to publish it, you are welcome to do so.

I am, very respectfully,

WILLIAM H. TUKEY,
Major, Medical Corps, U. S. A.,
Camp Sanitary, Inspector.

CAMP FUNSTON GARBAGE STAND

Holds six cans in second story. First story used for sacks of paper or galvanized iron cans of ashes, sweepings, bottles, etc. Base of second story is placed four feet from ground, so as to allow cans to be pulled by one man directly onto the platforms of the garbage trucks, which are 8 x 12 feet, and 3¾ feet from the ground and hold thirty cans.

Various devices can be added to the stand to suit special situations, such as placing a foot board in front similar to rear, except that it should be dropped a few inches, so as to allow placing of a skid when one is deemed advisable. If one or two of the end battens are extended upward a few inches, they will form rests or stops for the outside doors. The fly trap will brace the center door.

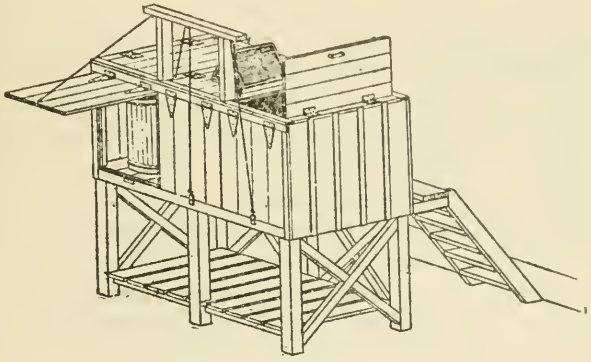
The cans are filled through the top doors, and are removed through the front doors.

FLY TRAP

The unique feature of this garbage stand is found in the fly trap. There is a large opening in the center top door over which is placed the trap. As the stand, when closed, is dark—the only light coming through the trap—the whole stand be-

comes a fly trap with the cans as bait. Any fly that gets inside is almost sure to meet his finish in the trap.

The garbage stands have been ordered placed at every kitchen in such locations that garbage trucks can load without the men getting off of the trucks or doing any lifting.



The two stories are built separate, though this is not necessary.

Materials required for the stands, without the base or first story, is enumerated below; but can be varied to suit the builder's convenience. In Camp Funston they are built from scrap lumber.

Bill of Material

Base Posts
6 posts 4 x 4 in. x 5 ft. 6 in.
Flooring—
4 pieces 2 x 10 in. x 6 ft. 4 in.
1 piece 2 x 8 in. x 6 ft. 4 in.
Floor Beams—
2 pieces 2 x 6 in. x 6 ft. 1 in.
2 pieces 2 x 6 in. x 5 ft.
1 piece 2 x 6 in. x 3 ft. 9 in.
Framing Uprights—
4 pieces 2 x 4 in. x 2 ft. 9 in.
2 pieces 2 x 4 in. x 5 ft.
Plates—
2 pieces 2 x 4 in. x 6 ft. 4 in.
2 pieces 2 x 4 in. x 4 ft.
1 piece 2 x 4 in. x 3 ft. 6 in.
2 pieces 2 x 4 in. x 3 ft. 7 in.
Siding For Ends—
12 pieces 1 x 8 in. x 3 ft.
Siding for Back—
7 pieces 1 x 10 in. x 3 ft.
1 piece 1 x 8 in. x 3 ft.
Finishing Lumber—
2 pieces 1 x 3 in. x 6 ft. 4 in.
2 pieces 1 x 3 in. x 3 ft. 9 in.
18 pieces 1 x 3 in. x 1 ft. 8 in.
18 pieces 1 x 3 in. x 1 ft. 11 in.
2 pieces 1 x 2 in. x 3 ft. 6 in.
3 pieces 1 x 10 in. x 3 ft. 7 in.
3 pieces 1 x 12 in. x 3 ft. 7 in.
3 pieces 1 x 10 in. x 3 ft.
3 pieces 1 x 12 in. x 3 ft.
70 feet 1 x 1 1-2 in.
Hardware—
3 pair butt hinges, 2½ x 2½ in.
3 pair Tee hinges, 3 x 6 in.
72 1in. No. 10 F. H. screws.
5 lbs. 16D nails.
5 lbs. 5D nails.
3 pulleys, 1½ in.
30 ft. sash cord.

AN IMPROVEMENT OF THE AEROPLANE SPLINT

By Captain FRANK W. ROMAINE
Medical Corps, United States Army

(With three illustrations)

During the European war many varieties of splints have come into vogue. Some of them were resurrected from the discard and put into use, while others combined old ideas with new positions and arrangements. Among the various mechanical supports is the "Aeroplane" splint used for fractures of the surgical and anatomical necks of the humerus, gunshot wounds of the shoulder involving the joint and wounds of the outer end of the clavicle and spine of the scapula. This splint has been used to great advantage and with much comfort to the patient, both before and after operative procedure. But, as devised, it does not meet all the requirements of the long convalescence of these types of cases. A later style has practically the same objections, as it does not permit of lowering the arm with support in the axilla, the point where support is most needed.

Fig. 1 (the original splint) shows the rigid support—the idea in the first weeks of convalescence to maintain the arm and forearm at right angles to the body.

Fig. 2 shows the splint devised to permit the lowering of the arm and forearm. In this type the support of the arm and forearm is lowered *en masse* by loosening the thumb screw A (Fig. 2) and allowing the upright rod to slide down to the desired distance, when the screw is tightened. This permits of a relaxation at a point where support is most desired and a general sagging of the arm, causing a greater strain at the point most needing support. This splint has been found to be undesirable, uncomfortable and painful to the patient.

In the improved splint, Fig. 3, as devised and used on war wounds of the shoulder involving the head of the humerus, clavicle and scapula, a happier result is obtained. A greater degree of comfort is afforded the patient, a rest is established for the arm and forearm and support is maintained in the axilla. The lowering and raising of arm and forearm are executed without disturbing the dressings or requiring the removal of the splint.

In Fig. 3, at the angle formed by the horizontal and perpendicular rods, a hinge (A) is made. A band of steel ¾ inch wide and 2¼ inches long is riveted to the horizontal rod 1¼ inches from A. At point B is hinged a band similar to the first, 2¾ inches long, connected at an angle of 45 degrees with a sliding double sleeve (D) which is fitted with a thumb screw (E) permitting the lowering and raising of the sleeve and the consequent movement of the horizontal arm support. The upright between the points A and G is roughened, permitting the thumb screw (E) to bite and hold firmly.

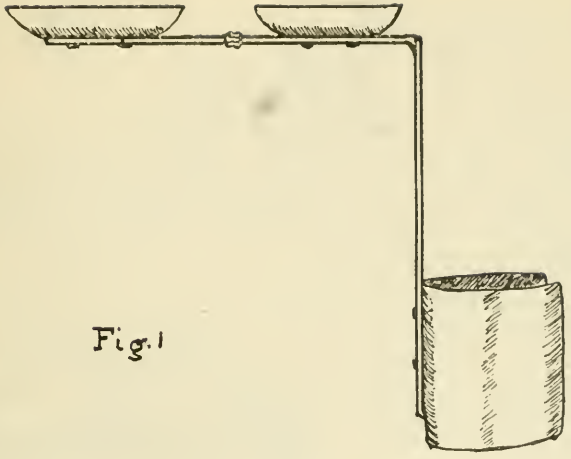


Fig. 1

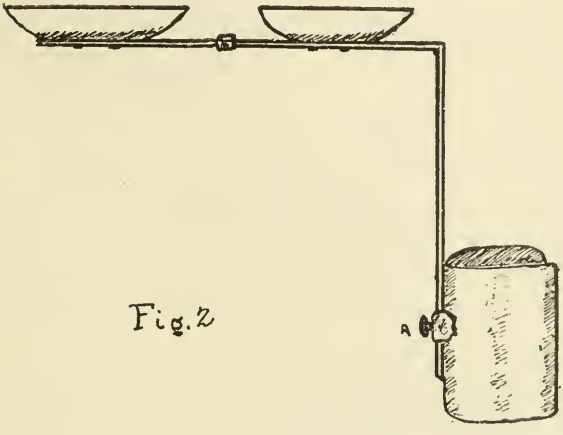


Fig. 2

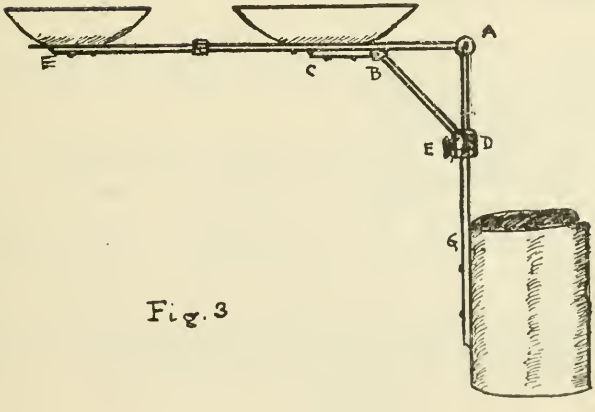


Fig. 3

Obituary

MISS JANE A. DELANO

Miss Jane A. Delano, who died on April 15 at Base Hospital No. 8, Sauvigny, France, was one of the foremost figures of the nursing world. It was under her direction that more than 30,000 nurses were recruited through the American Red Cross for service with the Army and Navy after the United States entered the great conflict. She was born in Watkins, N. Y., in 1862. Her father was killed in the Civil War and she was reared by her grandfather, a Baptist clergyman.

The call to relieve suffering humanity came to her while still a young girl, and after her preliminary education she began fitting herself for the career in which she was destined to attain such great prominence.

Miss Delano graduated from Bellevue Hospital, New York, in 1886, and two years later rendered her first patriotic service to her country by volunteering to nurse yellow fever victims in Jacksonville, Fla. Up to the time Miss Delano and a few other courageous trained nurses went to Jacksonville from New York the fever patients had been cared for by some negro nurses, who, while willing and devoted, lacked the scientific skill necessary to combat successfully the dread malady.

Her work in Jacksonville finished, Miss Delano was called to Bisbee, Ariz., in 1889, to establish a hospital for one of the big copper companies. Two years later she was made superintendent of the nurses' training school of the University of Pennsylvania, a position she held for five years.

When the American Red Cross, following the reorganization in 1906, entered into an agreement with the American Nurses' Association for the purpose of developing a nursing reserve for the Army Nurses Corps, Miss Delano was appointed chairman of the committee in charge of the work.

Miss Delano served three times as president of the American Nurses' Association and was for several years head of the directorate of the *American Journal of Nursing.*

She was a woman of striking personality and appearance. Regal in carriage, a mass of snow-white hair crowning a strong, but kindly face, she was a commanding figure in any gathering. A gentle manner and sympathy that was boundless won for her a great circle of friends.

Miss Delano served the American Red Cross from first to last without compensation—a full-time volunteer. She was the last of her family, her passport application, filed a few months ago, giving the name of a prominent nurse as her "nearest relative."

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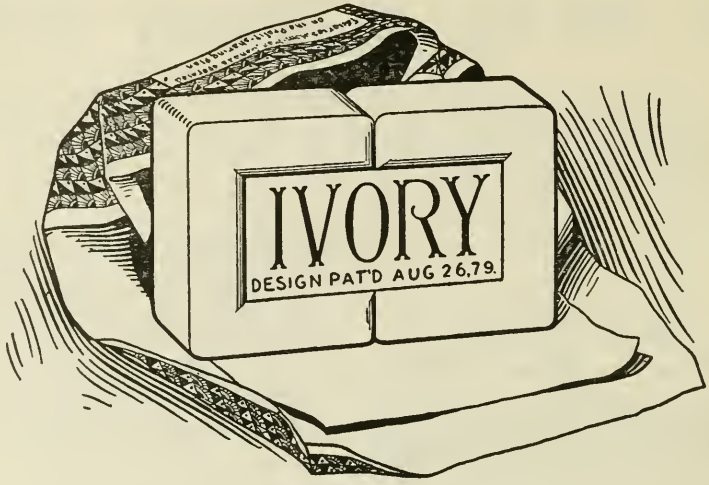

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Feed small amounts at frequent intervals.

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***Second Prize*—"The Relation of Defective Mental and Nervous State to Military Efficiency."**

Each competitor must furnish five copies of his competitive essay. Essays must not be signed with the true name of the writer, but are to be identified by a nom de plume or distinctive device. They must be forwarded to the Secretary of The Association of Military Surgeons of the United States, Army Medical Museum, Washington, D. C., so as to arrive at a date not later than January 1, 1920, and be accompanied by a sealed envelope marked on the outside with the fictitious name or device assumed by the writer and inclosing his true name, title and address. Essays must not contain less than 5,000 or more than 20,000 words, exclusive of tables. Announcement of the prize winners will be made in a subsequent issue of the journal as soon as the decision of the Board of Award is made known. The winning essays become the property of The Association and will be published in THE MILITARY SURGEON. The writers of the essays receiving "first honorable mention" will be awarded life membership in The Association of Military Surgeons of the United States.

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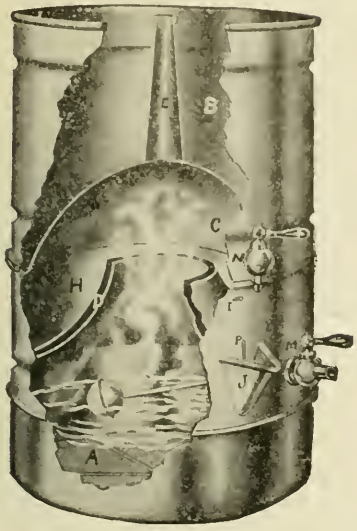

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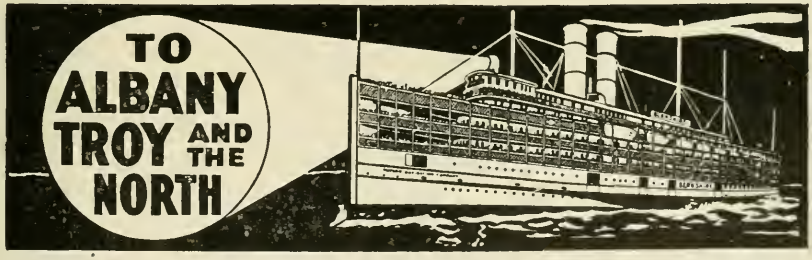

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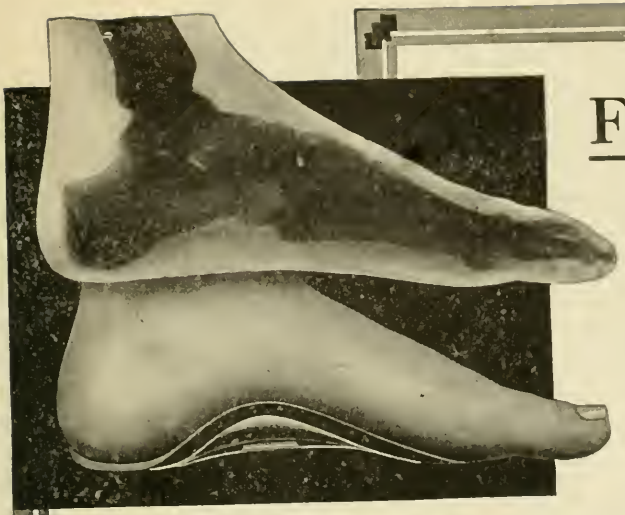

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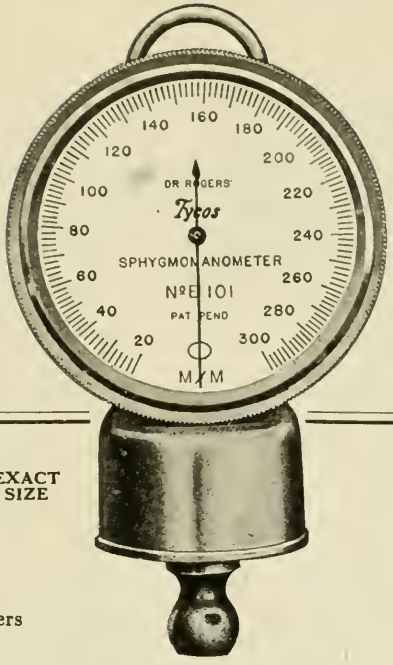

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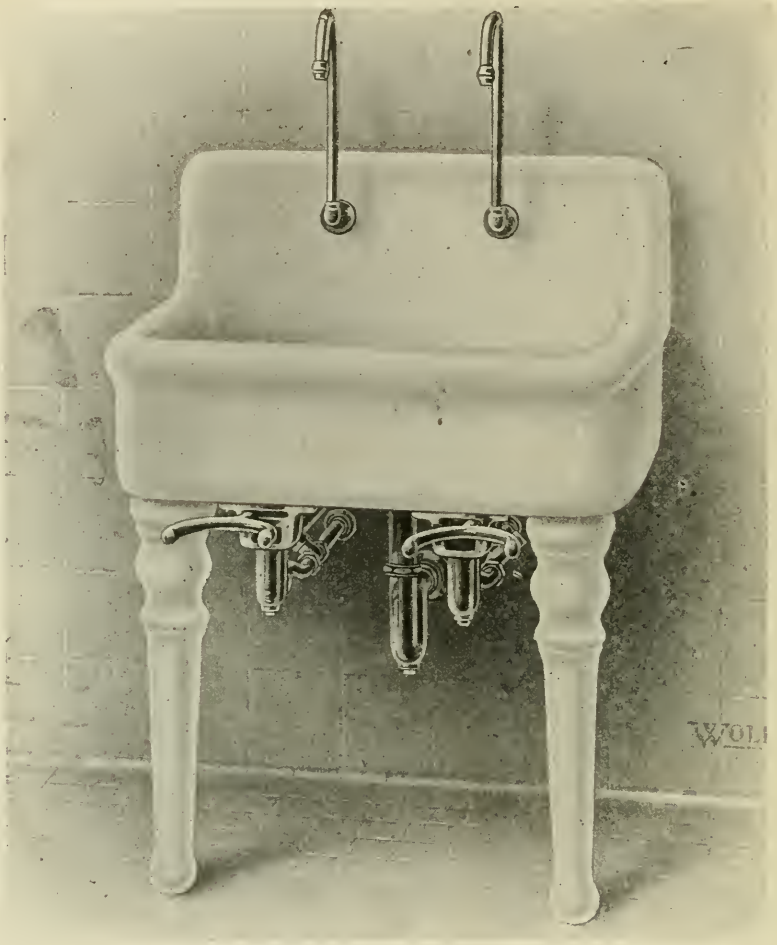

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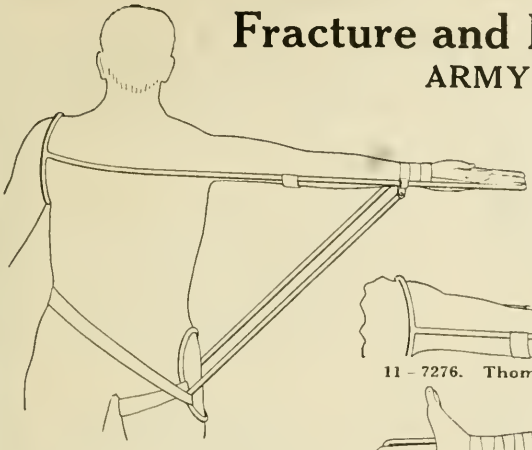

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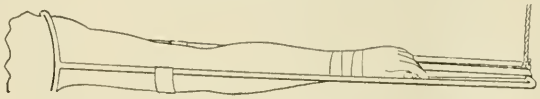

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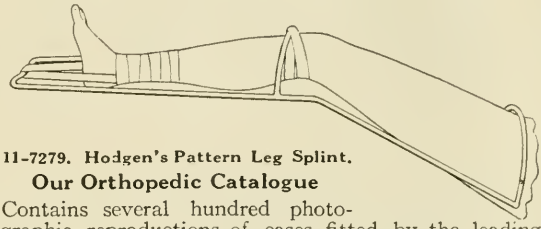

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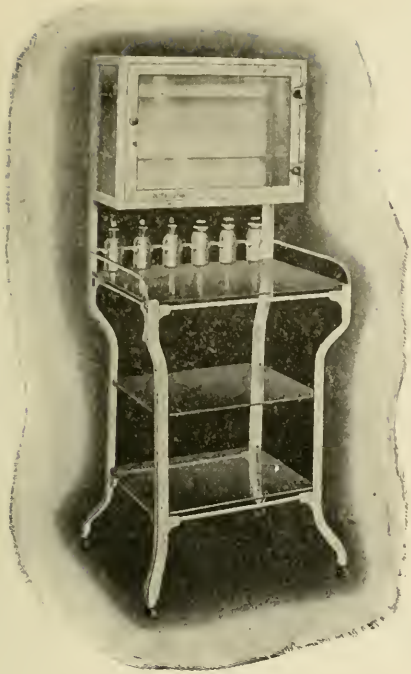

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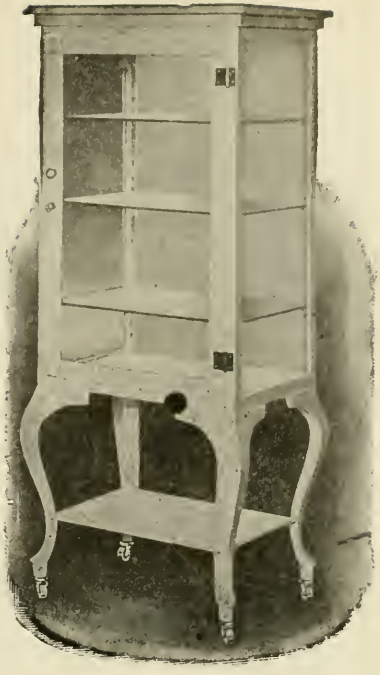

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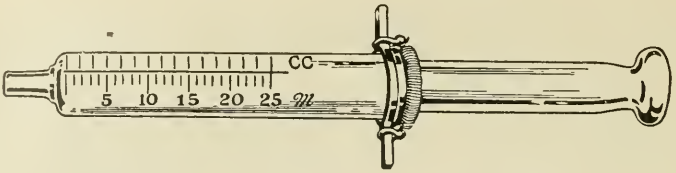

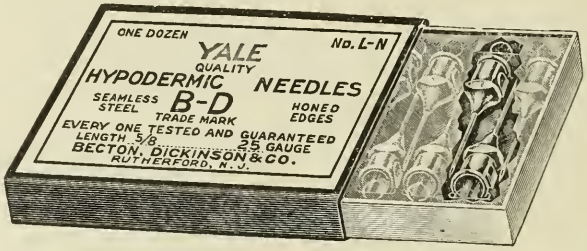

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